- Specifications

Description			Specifications	Limit
General				
Type			V - type, DOHC	
Number of cylinders			6	
Bore			96 mm (3.7795 in.)	
Stroke			87.0 mm (3.4252 in)	
Total displacement			3,778 cc (230.55 cu.in)	
Compression ratio			13.0 : 1	
Firing order			1 - 2 - 3 - 4 - 5 - 6	
Valve timing				
Intake	Opens (ATDC)		BTDC 65° - ATDC 20°	
	Closes (ABDC)		ABDC 27° - ABDC 112°	
Exhaust	Opens (BBDC)		BBDC 52° - BBDC 2°	
	Closes (ATDC)		ATDC 0° - ATDC 50°	
Cylinder head				
Flatness of gasket surface			Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.) / 150 x 150]	
Flatness of manifold mounting	Intake		Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.) / 110 x 110]	
	Exhaust		Less than 0.1 mm (0.0039 in.) [Less than 0.03 mm (0.001 in.) / 110 x 110]	
Camshaft				
Cam height	LH Camshaft	Intake	47.2 mm (1.8582 in)	
		Exhaust	45.8 mm (1.8031 in.)	
	RH Camshaft	Intake	47.2 mm (1.8582 in)	
		Exhaust	45.8 mm (1.8031 in.)	
Journal outer diameter	LH, RH camshaft	Intake	No.1 : 30.954 - 30.968 mm (1.2186 - 1.2192 in) No.2, 3, 4 : 23.963 - 23.977 mm (0.9434 - 0.9439 in)	
		Exhaust	No.1 : 27.964 - 27.978 mm (1.1009 - 1.1015 in.) No.2,3,4: 23.954 - 23.970 mm (0.9430 - 0.9437 in.)	
Bearing oil clearance	LH, RH camshaft	Intake	No.1 : 0.037 - 0.067 mm (0.0014 - 0.0026 in) No.2, 3, 4 : 0.030 - 0.058 mm (0.0011 - 0.0022 in)	
		Exhaust	No.1: 0.027 - 0.057 mm (0.0011 - 0.0022 in.) No.2, 3, 4: 0.037 - 0.067 mm (0.0015 - 0.0026 in)	
End play		Intake	0.04 - 0.18 mm (0.0015 - 0.0070 in)	
		Exhaust	0.02 - 0.18 mm (0.0007 - 0.0070 in)	
Valve				
Valve length	Intake		105.27mm(4.1445 in.)	
	Exhaust		105.50 mm (4.1535 in.)	
Stem outer diameter	Intake		5.465 - 5.480 mm (0.2151 - 0.2157 in.)	
	Exhaust		5.458 - 5.470 mm (0.2149 - 0.2153 in.)	
Face angle			45.25° - 45.75°	
Thickness of	Intake		1.0 mm (0.0394 in.)	
	Exhaust		1.1 mm (0.0433 in.)	

valvehead(margin)			
Valve stem to valve guide clearance	Intake	0.020 - 0.047 mm (0.00078 - 0.00185 in.)	
	Exhaust	0.030 - 0.054 mm (0.00118 - 0.00212 in.)	
Valve guide			
Inner diameter	Intake	5.500 - 5.512 mm (0.2165 - 0.2170 in.)	
	Exhaust	5.500 - 5.512 mm (0.2165 - 0.2170 in.)	
Length	Intake	41.8 - 42.2 mm (1.6457 - 1.6614 in.)	
	Exhaust	41.8 - 42.2 mm (1.6457 - 1.6614 in.)	
Valve seat			
Width of seat contact	Intake	1.15 - 1.45 mm(0.05118 - 0.05709 in.)	
	Exhaust	1.35 - 1.65 mm(0.05315 - 0.06496 in.)	
Seat angle	Intake	44.75° - 45.20°	
	Exhaust	44.75° - 45.20°	
Valve spring			
Free length		46.2 mm (1.8188 in)	
Load		19.4 ± 0.8kg / 34.0 mm (42.7 ± 1.8 lb / 1.3386 in.)	
		39.3 ± 1.2kg / 23.8 mm (86.6 ± 2.6 lb / 0.9370 in.)	
Out of squareness		Less than 1.5°	
MLA			
MLA outer diameter	Intake	34.964 - 34.980 mm (1.3765 - 1.3772 in.)	
	Exhaust	34.964 - 34.980 mm (1.3765 - 1.3772 in.)	
Cylinder head tappet bore inner diameter	Intake	35.000 - 35.025 mm (1.3779 - 1.3789 in.)	
	Exhaust	35.000 - 35.025 mm (1.3779 - 1.3789 in.)	
MLA to tappet bore clearance	Intake	0.020 - 0.061 mm (0.0008 - 0.0024 in.)	0.07 mm (0.0027 in.)
	Exhaust	0.020 - 0.061 mm (0.0008 - 0.0024 in.)	0.07 mm (0.0027 in.)
Valve clearance (At 20°C [68°F])			
Intake		0.17 - 0.23 mm (0.0067 - 0.0090 in.)	
Exhaust		0.27 - 0.33 mm (0.0106 - 0.0129 in.)	
Cylinder block			
Cylinder bore		96.00 - 96.03 mm (3.7795 - 3.7807 in.)	
Flatness of gasket surface		Less than 0.05 mm (0.0019 in.) [Less than 0.02 mm (0.0008 in.) / 150 x 150]	
Piston			
Piston outer diameter		95.95 - 95.98 mm (3.7776 - 3.7787 in)	
Piston to cylinder clearance		0.04 - 0.06 mm (0.0016 - 0.0024 in.)	
Ring groove width	No. 1 ring groove	1.23 - 1.25 mm (0.0484 - 0.0492 in.)	
	No. 2 ring groove	1.23 - 1.25 mm (0.0484 - 0.0492 in.)	
	Oil ring groove	2.01 - 2.03 mm (0.0791 - 0.0799 in.)	
Piston ring			
Side clearance	No. 1 ring	0.04 - 0.08 mm (0.0015 - 0.0031 in.)	0.1 mm (0.004 in.)
	No. 2 ring	0.04 - 0.08 mm (0.0015 - 0.0031 in.)	0.1 mm (0.004 in.)
	Oil ring	0.02 - 0.06 mm (0.0008 - 0.0024 in.)	0.2 mm (0.008 in.)
End gap	No. 1 ring	0.17 - 0.24 mm (0.0067 - 0.0094 in.)	0.6 mm (0.0236 in.)
	No. 2 ring	0.32 - 0.47 mm (0.0126 - 0.0185 in)	0.7 mm (0.0275 in.)
	Oil ring	0.20 - 0.40 mm (0.0078 - 0.0157 in.)	0.8 mm (0.0315 in.)
Piston pin			

Piston pin outer diameter		21.097 - 22.000 mm (0.8305 - 0.8661 in.)	
Piston pin hole inner diameter		22.004 - 22.010 mm (0.8662 - 0.8665 in.)	
Piston pin hole clearance		0.004 - 0.013 mm (0.00015 - 0.00051 in.)	
Connecting rod small end inner diameter		22.005 - 22.016 mm (0.8663 - 0.8668 in.)	
Connecting rod small end hole clearance		0.005 - 0.019 mm (0.00019 - 0.00074 in.)	
Connecting rod			
Connecting rod big end inner diameter		58.000 - 58.018 mm (2.2834 -2.2842 in.)	
Connecting rod bearing oil clearance		0.042 - 0.060 mm (0.0017 - 0.0024 in.)	
Side clearance		0.1 - 0.25 mm (0.0039 - 0.0098 in.)	
Crankshaft			
Main journal outer diameter		68.942 - 68.960 mm (2.7142 - 2.7149 in.)	
Pin journal outer diameter		54.954 - 54.972 mm (2.1635 - 2.1642 in.)	
Main bearing oil clearance		0.023 - 0.041 mm (0.0009 - 0.0016 in)	
End play		0.10 - 0.28 mm (0.0039 - 0.0110 in.)	
Oil pump			
Regulating pressure		low pressure mode: 2.04kgf/cm(2bar) high pressure mode: 4.08kgf/cm(4bar)	
Engine oil			
Oil quantity	Total	6.7 L (7.08 US qt, 5.89 Imp qt, 1.77 US.gal)	Total Engine oil
	Oil pan	6.4 L (6.76 US qt, 5.63 Imp qt, 1.69 US.gal)	
	Drain and refill	6.5 L (6.87 US qt, 5.72 Imp qt, 1.72 US.gal)	Including oil filter
Oil grade	Recommended	5W30 ACEA A5	Refer to the "Lubrication System".
	Allowed	– API SM or above – ILSAC GF-4 or above – ACEA A3 – For information on SAE viscosity grades based on ambient temperatures, refer to the “lubrication system”	
Oil pressure (at 1000rpm)		117 kPa (1.2 kgf/cm², 17.07 psi) [at 1000 rpm, 110°C (230 °F)]	Oil temperature (oil pan): 110±2°C (230±35.6°F)
Cooling system			
Cooling method		Forced circulation with water pump	
Coolant quantity		11.98 L (12.66 US qt, 10.54 Imp qt, 3.16 US gal)	
Thermostat	Type	Wax pellet type	
	Opening temperature	100 ± 2°C (212 ± 35.6°F)	
	Fully opened temperature	113°C (235.4°F)	
	Full lift	8 mm (0.3150 in) or more	
Radiator cap	Main valve opening pressure	93.16 - 122.58 kpa (0.95 - 1.25kg/cm², 13.51 - 17.78 psi)	
	Vacuum valve opening pressure	0 - 6.86 kpa (0 - 0.07kg/cm², 0 - 0.99 psi)	

Tightening Torques

Item	N.m	kgf.m	lb-ft
Engine mounting			

Engine mounting bracket to body fixing bolt and nut	63.7 - 83.4	6.5 - 8.5	47.0 - 61.5
Engine mounting support bracket to engine mounting insulator fixing nut	98.1 - 117.7	10.0 - 12.0	72.3 - 86.8
Engine mounting support bracket to engine support bracket fixing bolt	98.1 - 117.7	10.0 - 12.0	72.3 - 86.8
Engine mounting support bracket to engine support bracket fixing nut	98.1 - 117.7	10.0 - 12.0	72.3 - 86.8
Transaxle mounting bracket to body fixing bolt	63.7 - 83.4	6.5 - 8.5	47.0 - 61.5
Transaxle mounting bracket to body fixing nut	63.7 - 83.4	6.5 - 8.5	47.0 - 61.5
Transaxle mounting support bracket to transaxle mounting insulator fixing bolt	107.9 - 127.5	11.0 - 13.0	79.6 - 94.0
Roll rod bracket to sub frame fixing bolt	49.0 - 63.7	5.0 - 6.5	36.2 - 47.0
Roll rod bracket to roll rod support bracket fixing bolt	107.9 - 127.5	11.0 - 13.0	79.6 - 94.0
Timing System			
Drive belt idler bolt	53.9 - 57.9	5.5 - 5.9	39.8 - 42.7
Drive belt auto tensioner bolt (M12)	81.4 - 85.3	8.3 - 8.7	60.0 - 62.9
Drive belt auto tensioner bolt (M8)	17.7 - 21.6	1.8 - 2.2	13.0 - 15.9
Crankshaft pulley bolt	421.7 - 431.5	43.0 - 44.0	311.0 - 318.3
Timing chain cover bolts A	18.6 - 21.6	1.9 - 2.2	13.7 - 15.9
Timing chain cover bolts B	24.5 - 26.5	2.5 - 2.7	18.1 - 19.5
Timing chain cover bolt C	58.8 - 68.6	6.0 - 7.0	43.4 - 50.6
Timing chain cover bolt D	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain auto tensioner bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain auto tensioner nuts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Timing chain auto tensioner arm bolts	18.6 - 21.6	1.9 - 2.2	13.7 - 15.9
Timing chain guide bolts	19.6 - 24.5	2.0 - 2.5	14.5 - 18.1
Timing chain cam to cam guide bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Cylinder head			
Cylinder head cover bolts (LH / RH)	[4.9 - 5.9] + [9.8 - 11.8]	[0.5 - 0.6] + [1.0 - 1.2]	[3.6 - 4.3] + [7.2 - 8.7]
Exhaust CVVT bolt (LH / RH)	64.7 - 76.5	6.6 - 7.8	47.7 - 56.4
Intake CVVT OCV & center bolt (LH / RH)	[24.5] + [55 - 61°]	[2.5] + [55 - 61°]	[18.1] + [55 - 61°]
Camshaft bearing cap bolts (LH / RH)	[5.8] + [9.8 - 11.8]	[0.6] + [1.0 - 1 .2]	[4.3] + [7.2 - 8.7]
Cylinder head bolts (LH / RH)	[37.3 - 41.2] + [118 - 122°] + [88 - 92°]	[3.8 - 4.2] + [118 - 122°] + [88 - 92°]	[27.5 - 30.4] + [118 - 122°] + [88 - 92°]
Cylinder head bolt (RH rear)	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Engine hanger bolt (Front)	44.1 - 53.6	4.5 - 5.5	32.5 - 39.8
Engine hanger bolts (Rear)	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Exhaust OCV(oil control valve) bolts (LH / RH)	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Variable force solenoid(VFS) bolt (LH / RH)	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Fuel pump bracket bolt	18.6 - 23.5	1.9 - 2.4	13.7 - 17.4
Cylinder block			
Connecting rod bolts	[27.5 - 31.3] + [68 - 72°]	[2.8 - 3.2] + [98 - 102°]	[20.2 - 23.1] + [98 - 102°]
Main bearing cap inner bolts (M11)	[49.0] + [90˚]	[5.0] + [90˚]	[36.2] + [90˚]
Main bearing cap outer bolts (M8)	[19.6] + [120˚]	[2.0] + [120˚]	[14.5] + [120˚]
Main bearing cap side bolts (M8)	29.4 - 31.4	3.0 - 3.2	21.7 - 23.1
Oil drain cover bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Oil jet bolts	27.5 - 31.3	2.8 - 3.2	20.2 - 23.1

Rear oil seal case bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Baffle plate bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Knock sensor bolts (LH / RH)	15.7 - 23.5	1.6 - 2.4	11.6 - 17.4
Variable force solenoid(VFS) bolt (LH / RH)	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Drive plate bolts	71.54 - 75.46	7.3 - 7.7	52.80 - 55.69
Upper oil pan bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Lubrication system			
Oil drain bolt	34.3 - 44.1	3.5 - 4.5	25.3 - 32.5
Oil pump bolts	20.6 - 22.6	2.1 - 2.3	15.2 - 16.6
Oil filter body bolts	23.5 - 25.5	2.4 - 2.6	17.4 - 18.8
Oil filter cap	31.4 - 38.2	3.2 - 3.9	23.1 - 28.2
Oil level gauge bolt	18.6 - 22.6	1.9 - 2.3	13.7 - 16.6
Lower oil pan bolts	11.8 - 13.7	1.2 - 1.4	8.7 - 10.1
Oil pump chain tensioner bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Oil pump chain sprocket bolt	19.6 - 24.5	2.0 - 2.5	14.5 - 18.1
Cooling system			
Water pump bolts A	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Water pump bolt B	21.6 - 26.5	2.2 - 2.7	15.9 - 19.5
Water pump bolt C	21.6 - 23.5	2.2 - 2.4	15.9 - 17.4
Water pump bolt D	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Water pump bolt E	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Water pump pulley bolts	7.8 - 9.8	0.8 - 1.0	5.8 - 7.2
Water temp. control nuts	24.5 - 28.4	2.5 - 2.9	18.7 - 21.0
Water temp. control bolts	24.5 - 28.4	2.5 - 2.9	18.7 - 21.0
Water center pipe bolt	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Water outlet pipe mounting bolt	19.6 - 23.5	2.0 - 2.4	14.5 - 17.4
Water inlet/outlet pipe and water temp. control fixing bolt	19.6 - 23.5	2.0 - 2.4	14.5 - 17.4
Electric thermostat housing bolt	16.7 - 19.6	1.7 - 2.0	12.3 - 14.5
Intake and exhaust system			
Intake air hose clamp bolt	2.9 - 4.9	0.3 - 0.5	2.2 - 3.6
Air cleaner assembly bolts	7.8 - 9.8	0.8 - 1.0	5.8 - 7.2
Intake manifold bolts	[3.9 - 5.9] + [26.5 - 31.4]	[0.4 - 0.6] + [2.7 - 3.2]	[2.9 - 4.3] + [19.5 - 23.1]
Surge tank stay bolts	27.5 - 31.3	2.8 - 3.2	20.2 - 23.1
Surge tank bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Surge tank grommet bolts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Surge tank nuts	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Heat protector bolts (LH / RH)	9.8 - 11.8	1.0 - 1.2	7.2 - 8.7
Exhaust manifold stay bolts	24.5 - 35.3	2.5 - 3.6	18.1 - 26.0
Exhaust manifold nuts (LH / RH)	49.0 - 53.9	5.0 - 5.5	36.2 - 39.8
Front muffler nut	39.2 - 58.8	4.0 - 6.0	28.9 - 43.4
Center muffler nut	39.2 - 58.8	4.0 - 6.0	28.9 - 43.4
Rear muffler nut	39.2 - 58.8	4.0 - 6.0	28.9 - 43.4

NOTICE

- Torque - to - yield cylinder head, connecting rod cap and crankshaft main bearing cap bolts must be replaced once removed because the bolts are designed to be permanently elongated beyond the state of elasticity when torqued.
- If removed bolts are reused, the bolts may break or fail to maintain clamping force.

- Compression Pressure Inspection

NOTICE

- If the there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. Warm up engine until the normal operating temperature (80 - 95°C (176-203°F)).
2. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
3. Remove the battery.
   (Refer to Engine Electrical System - "Battery")
4. Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System - "Air Cleaner")
5. Remove the surge tank.
   (Refer to Intake And Exhaust System - "Surge Tank")
6. Remove the ignition coils.
   (Refer to Engine Electrical System - "Ignition Coil")
7. Remove the spark plugs.
   (Refer to Engine Electrical System - "Spark Plug")
8. Check cylinder compression pressure.
   (1) Insert a compression gauge into the spark plug hole.
   (2) Fully open the throttle.
   (3) Crank the engine over 7 times to measure compression pressure.

NOTICE

- Always use a fully charged battery to obtain engine speed of 250 rpm or more.

   (4) Repeat step 1) though 3) for each cylinder.

NOTICE

- This measurement must be done in as short a time as possible.

Compression pressure :
1,373 kPa (14.0 kgf/cm², 199 psi) (250 - 400 rpm)
Minimum pressure :
1226 kPa (12.5 kgf/cm², 178 psi)
Difference between each cylinder :
98kPa (1.0kg/cm², 14psi) or less

   (5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat step 1) through 3) for cylinders with low compression.
      a. If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.

b. If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

9. Reinstall the spark plugs.
10. Install the ignition coils and ignition connectors.
11. Install the surge tank.
    (Refer to Intake And Exhaust System - "Surge Tank")

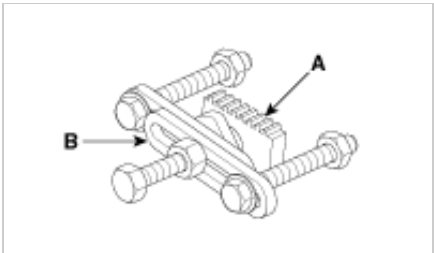
- Troubleshooting

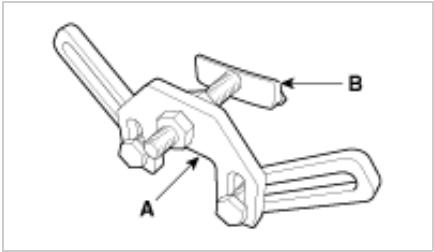
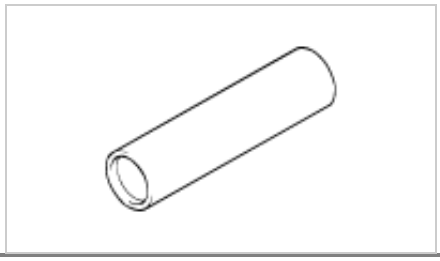
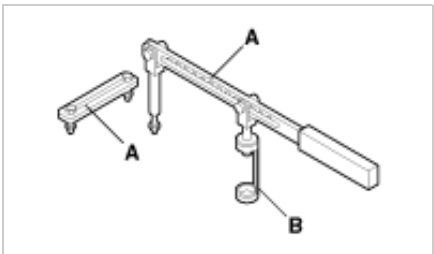
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Worn crankshaft bearings. Loose or damaged engine drive plate.	Replace the crankshaft and bearings as required. Repair or replace the drive plate as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption.	• Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system • Coolant consumption may or may not cause the engine to overheat.	• Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. • Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	• Inspect the cylinder for a loss of compression. • Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	• Drain the oil. • Install the correct viscosity oil.
	NOTICE • Minor engine clatter sound immediately upon cold start for very brief period may be normal.	
Upper engine noise,regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
		•

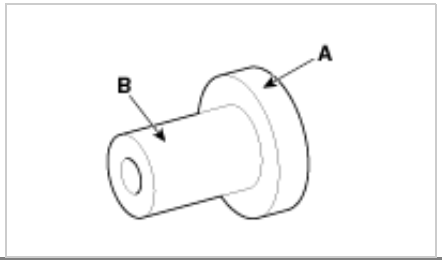
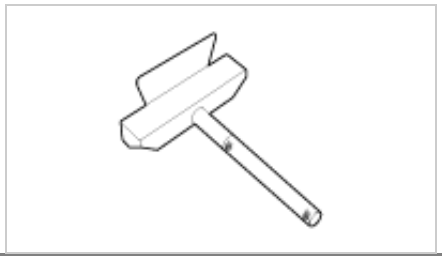
	Worn camshaft lobes.	Inspect the camshaft lobes. • Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
	Worn drive belt, idler, tensioner and bearing.	Replace as required.
Lower engine noise,regardless of engine speed.	Low oil pressure.	Repair as required.
	Loose or damaged drive plate.	Repair or replace the drive plate.
	Damaged oil pan, contacting the oil pump screen.	• Inspect the oil pan. • Inspect the oil pump screen. • Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	• Inspect the oil pump screen. • Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	• Inspect the piston, piston pin and cylinder bore. • Repair as required.
	Excessive piston pin-to-piston clearance.	• Inspect the piston, piston pin and the connecting rod. • Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. • The connecting rod bearings. • The connecting rods. • The crankshaft pin journals.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block.
	Incorrect piston, piston pin and connecting rod installation	• Verify the piston pins and connecting rods are installed correctly. • Repair as required.
Engine noise under load.	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance .	Inspect the following components and repair as required : • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components, and repair as required. • The crankshaft bearings. • The crankshaft main journals.

		• The cylinder block.
Engine will not crank-crankshaft will not rotate.	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder.	1) Remove spark plugs and check for fluid. 2) Inspect for broken head gasket. 3) Inspect for cracked engine block or cylinder head. 4) Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain and/or timing chain gears.	1) Inspect timing chain and gears. 2) Repair as required.
	Material in cylinder. • Broken valve • Piston material • Foreign material	1) Inspect cylinder for damaged components and/or foreign materials. 2) Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1) Inspect crankshaft and connecting rod bearing. 2) Repair as required.
	Bent or broken connecting rod.	1) Inspect connecting rods. 2) Repair as required.
	Broken crankshaft.	1) Inspect crankshaft. 2) Repair as required.

- Special Service Tools

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-3C100)	Click to see large image...	Installation of the front oil seal
Ring gear stopper A : 09231-3N100 B : 09231-2B100		Removal and installation of crankshaft pulley bolt

Ring gear stopper A : 09231-3D100 B : 09231-2W100		Removal and installation of crankshaft pulley bolt.
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method
Valve stem seal remover (09222-29000)	Click to see large image...	Removal of the valve stem seal
Valve stem seal installer (09222-3C100)		Installation of the valve stem seal
Valve spring compressor & holder A : 09222-3K000 B : 09222-3K100		Removal and installation of the intake or exhaust valves
Crankshaft rear oil seal installer		Installation of the crankshaft rear oil seal

A : 09231-3C200 B : 09231-H1100		
Oil pan remover (09215-3C000)		Removal of oil pan

- Removal and Installation

1. Remove the engine cover (A).

NOTICE

- Lift up the lower end of engine cover, then left and right alternately.
- When installing, confirm that the mounting rubber insulators has been installed.

2. Install in the reverse order of removal.

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the engine room under cover (A).

Tightening torque:

7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

Click to see large image...

2. Install in the reverse order of removal.

- Components

Click to see large image...

1. Transaxle mounting bracket
2. Roll rod bracket
3. Engine mounting support bracket
4. Engine mounting bracket
5. Roll rod upper bracket

Click to see large image...

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

[Engine mounting bracket]

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Install the jack to the edge of lower oil pan (A) to support the engine.

Click to see large image...

NOTICE

- Insert the rubber block between jack and lower oil pan.

3. Remove the engine mounting support bracket (A).

Tightening torque:
98.1 - 117.7 N.m (10.0 - 12.0 kgf.m, 72.3 - 86.8 lb-ft)

Click to see large image...

NOTICE

- Do not reuse nuts.

4. Remove the engine mounting bracket (A).

Tightening torque :
63.7 - 83.4 N.m (6.5 - 8.5 kgf.m, 47.0 - 61.5 lb-ft)

Click to see large image...

5. Install in the reverse order of removal.

[Roll rod bracket]

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Remove the roll rod bracket (A).

Tightening torque

Bolt (B):

107.9 - 127.5N.m (11.0 - 13.0kgf.m, 79.6 - 94.0lb-ft)

Bolts (C):
49.0 - 63.7N.m (5.0 - 6.5kgf.m, 36.2 - 47.0lb-ft)

Click to see large image...

3. Remove the roll rod mounting support bracket (A).

Tightening torque :
49.0 - 68.6 N.m (5.0 - 7.0 kgf.m, 36.2 - 50.6 lb.ft)

Click to see large image...

4. Install in the reverse order of removal.

[Transaxle Mounting Bracket]

1. Disconnect the battery negative terminal.
2. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
3. Disconnect the battery positive terminal.
4. Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System - "Air Cleaner")

5. Remove the battery and battery tray.
   (Refer to Engine Electrical System - "Battery")
6. Remove the engine control module (ECM).
   (Refer to Engine Control / Fuel System - "Engine Control Module (ECM)")
7. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
8. Install jack under the transaxle to support it.

> **NOTICE**
>
> • Insert a rubber block between jack and transaxle.

9. Remove the service cover (A).

Click to see large image...

10. Remove the transaxle support bracket mounting bolts (A).

Tightening torque :
107.9 - 127.5 N.m (11.0 - 13.0 kgf.m, 79.6 - 94.0 lb-ft)

Click to see large image...

11. Remove the air cleaner bracket (A).

Tightening torque :
7.8 - 9.8 N.m (0.8 - 1.0 kgf.m, 5.8 - 7.2 lb.ft)

12. Remove the transaxle mounting bracket (B).

Tightening torque :
63.7 - 83.4 N.m (6.5 - 8.5 kgf.m, 47.0 - 61.5 lb-ft)

Click to see large image...

13. Install in the reverse order of removal.

Engine Mechanical System

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTICE

- Mark all wiring and hoses to avoid misconnection.

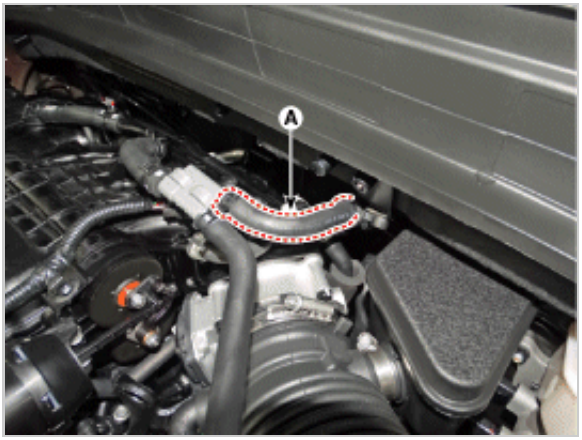
1. Disconnect the battery negative terminal.
2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
4. Disconnect the battery positive terminal.
5. Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System - "Air Cleaner")
6. Remove the battery and battery tray.
   (Refer to Engine Electrical System - "Battery")
7. Remove the engine control module (ECM).
   (Refer to Engine Control / Fuel System - "Engine Control Module (ECM)")
8. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
9. Drain the engine coolant.
   (Refer to Cooling System - "Coolant")
10. Disconnect the radiator upper hose (A).

Click to see large image...

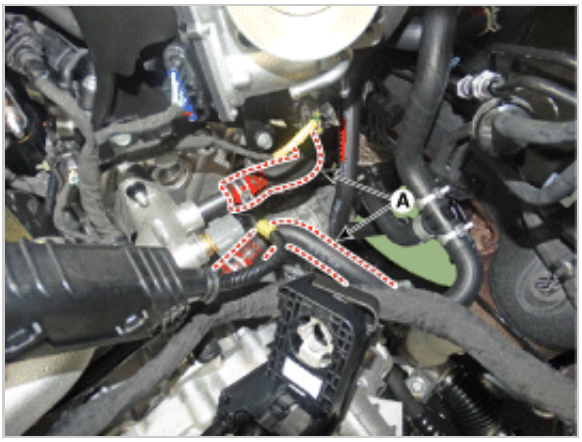
11. Disconnect the radiator lower hose (A).

Click to see large image...

12. Disconnect the brake booster vacuum hose (A).



13. Disconnect the heater hoses (A).

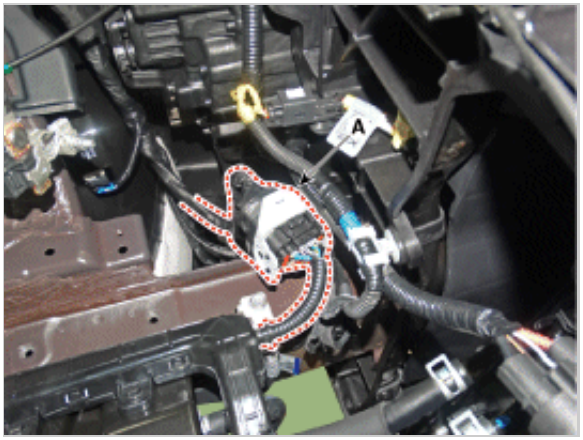


14. Disconnect the fuel hose (A) and the purge control solenoid valve (PCSV) hose (B).

Tightening torque :
3.9 - 5.9 N.m (0.4 - 0.6 kgf.m, 2.9 - 4.3 lb.ft)

15. Recover the refrigerant and then remove the high pressure pipe and low pressure pipe.
(Refer to Heating, Ventilation Air conditioning - "Compressor")

16. Remove the engine wiring connector and harness.
(1) Disconnect the front connector (A).

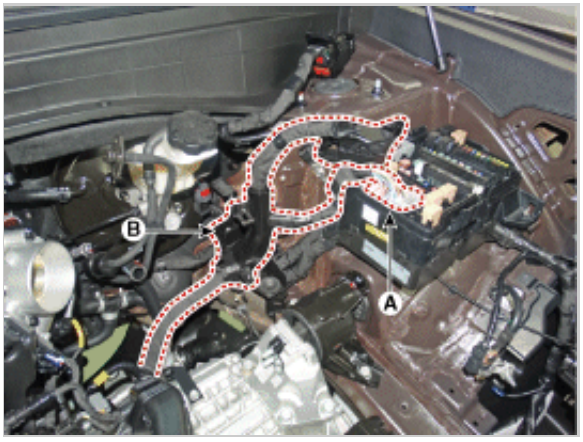


(2) Disconnect the fuse box wiring cable (A).

(3) Remove the battery wiring protector (B).

(4) Disconnect the fuse box main wiring connector (A).

(5) Remove the main wiring protector (B).



17. Disconnect the ATF cooler hoses (A).

18. Remove the roll rod bracket (A).

Tightening torque

Bolt (B) : 107.9 - 127.5 N.m (11.0 - 13.0 kgf.m, 79.6 - 94.0 lb.ft)

Bolts (C) : 49.0 - 63.7 N.m (5.0 - 6.5 kgf.m, 36.2 - 47.0 lb.ft)

Click to see large image...

19. Remove the roll rod mounting support bracket (A).

Tightening torque :
49.0 - 68.6 N.m (5.0 - 7.0 kgf.m, 36.2 - 50.6 lb.ft)

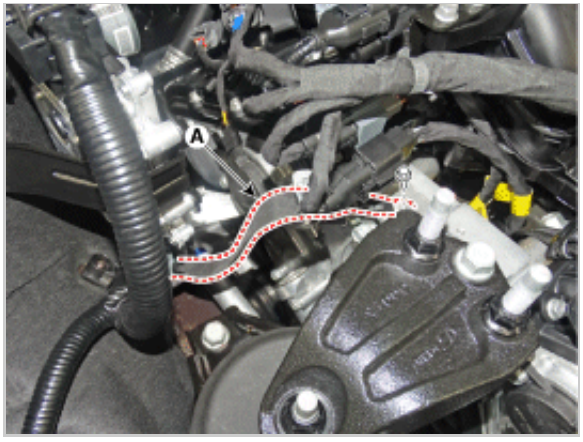
Click to see large image...

20. Disconnect the front driveshaft from the front hub axle.
    (Refer to Driveshaft and Axle - "Front Driveshaft")
21. Remove the sub frame.
    (Refer to Suspension System - "Sub frame")
22. Remove the front muffler.
    (Refer to Intake and Exhaust System - "Muffler")
23. Remove the propeller shaft. [AWD type]
    (Refer to Driveshaft and Axle - "Propeller Shaft Assembly")
24. Support the engine and transaxle assembly on a lift table.

25. Disconnect the engine ground cable (A).

Tightening torque :

10.8 - 13.7 N.m (1.1 - 1.4 kgf.m, 8.0 - 10.1 lb.ft)



26. Remove the engine mounting support bracket (A).

Tightening torque :

98.1 - 117.7 N.m (10.0 - 12.0 kgf.m, 72.3 - 86.8 lb-ft)

Click to see large image...

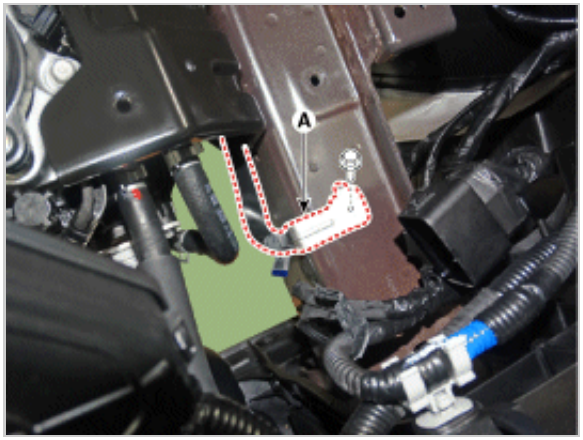
NOTICE

- Do not reuse nuts.

27. Disconnect the transaxle ground cable (A).

Tightening torque :

10.8 - 13.7 N.m (1.1 - 1.4 kgf.m, 8.0 - 10.1 lb.ft)



28. Remove the service cover (A).

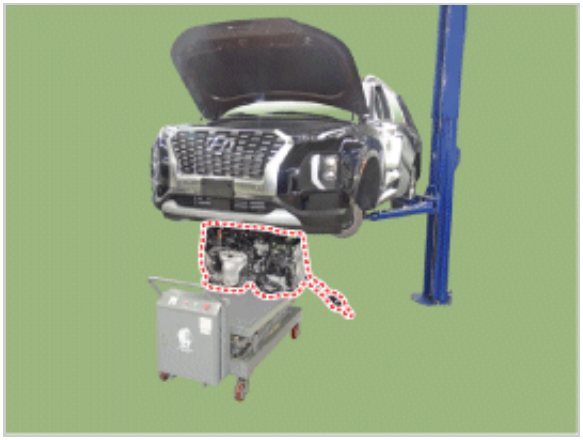
Click to see large image...

29. Remove the transaxle support bracket mounting bolts (A).

Tightening torque :
107.9 - 127.5 N.m (11.0 - 13.0 kgf.m, 79.6 - 94.0 lb.ft)

Click to see large image...

30. Remove the engine and transaxle assembly by lifting vehicle.



NOTICE

- Before removing the engine and transaxle assembly, make sure hoses and wire connectors are disconnected.
- When removing the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

- Installation

Installation is in the reverse order of removal.

Perform the following :

- Adjust a shift cable.
- Refill engine with engine oil.
- Refill a transaxle with fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Place a heater control knob on "HOT" position.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.

– After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

– Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

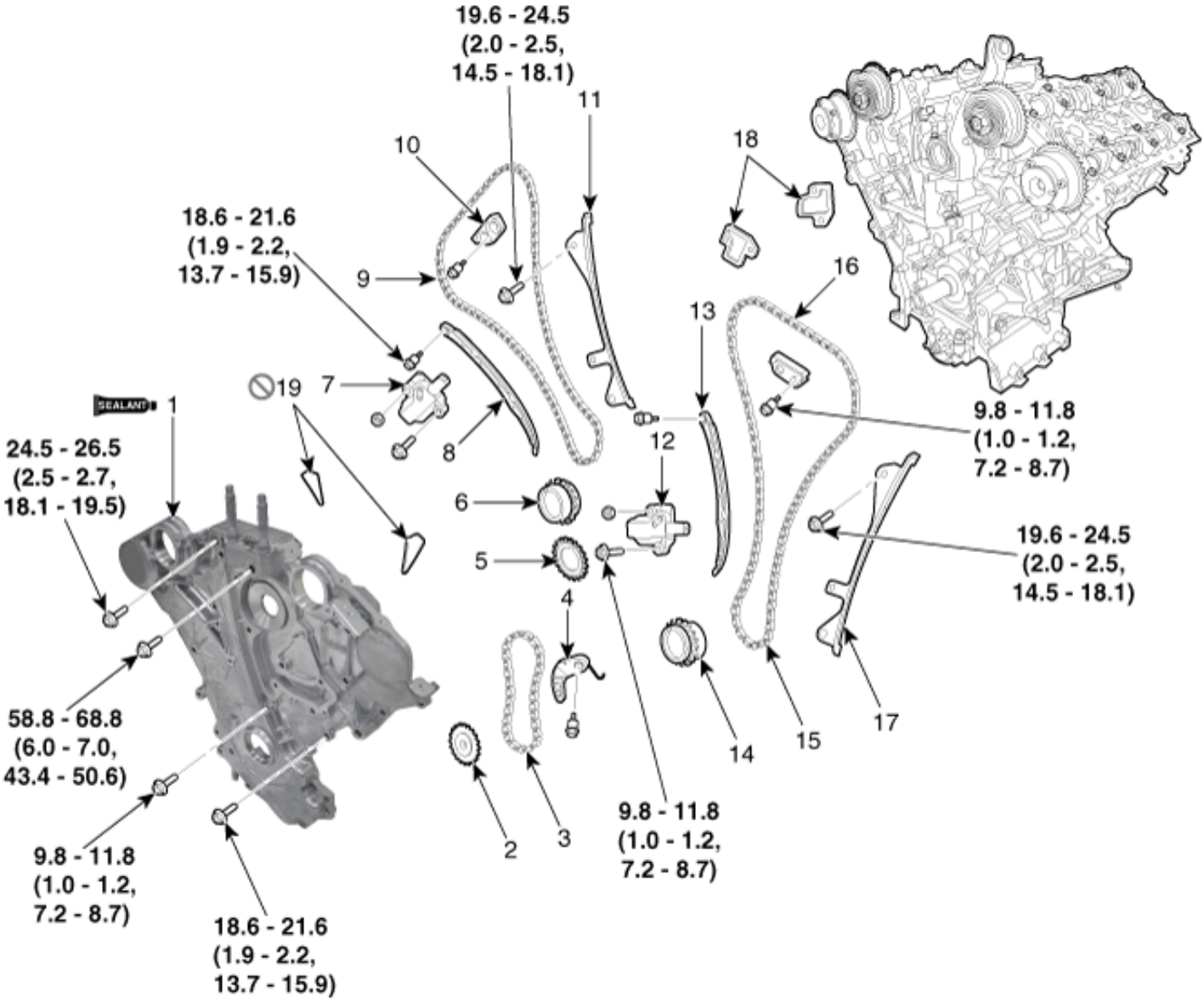
- Bleed air from the cooling system.

– Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)

– Turn Off the engine and let it cool down. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.

– Put radiator cap on tightly, then run the engine again and check for leaks.

- Components



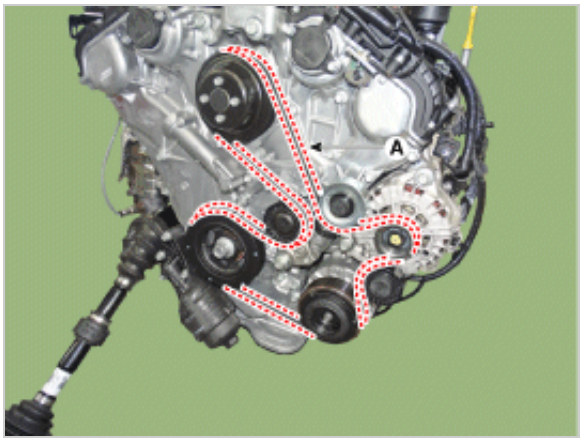
Tightening torque : N.m (kgf.m, lb-ft)

1. Timing chain cover
2. Oil pump sprocket
3. Oil pump chain
4. Oil pump tensioner assembly
5. Crankshaft oil pump sprocket
6. Crankshaft RH chain sprocket
7. RH Timing chain auto tensioner
8. RH Timing chain tensioner arm
9. RH Timing chain
10. RH Timing chain cam to cam guide
11. RH Timing chain guide
12. LH Timing chain auto tensioner
13. LH Timing chain tensioner arm
14. Crankshaft LH chain sprocket
15. LH Timing chain
16. LH Timing chain cam to cam guide
17. LH Timing chain guide
18. Tensioner adapter
19. Gasket

- Removal and Installation

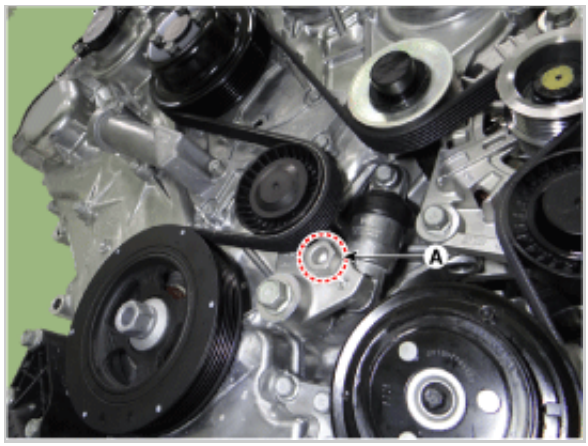
- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. To release the tension, turn the drive belt tensioner counterclockwise and then remove the drive belt (A).



NOTICE

- Install the drive belt in the following order :
  Crankshaft damper pulley → A/C compressor pulley → Idler Pulley → alternator pulley → Idler pulley → water pump pulley → drive belt auto tensioner pulley.
  Rotate the auto tensioner arm by turning the auto tensioner arm boss (A) counterclockwise using a wrench. After installing the drive belt to the auto tensioner pulley, slowly release the auto tensioner arm.



3. Install in the reverse order of removal.

- Inspection

Check belt for maintenance and V-ripped part for abnormal wear. Replace if necessary.

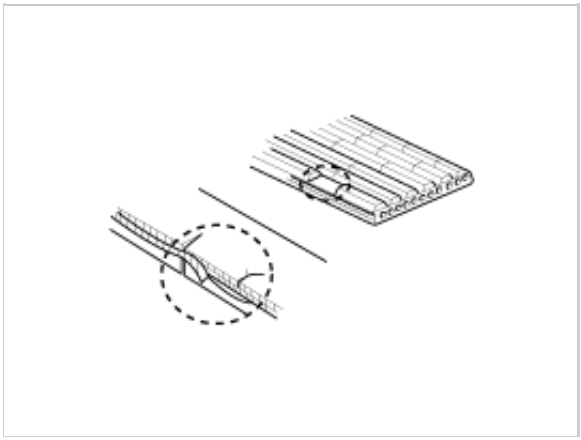
NOTICE

- Do not bend, twist or turn the drive belt inside out.
- Do not allow the drive belt to come into contact with oil, water and steam.

Visually check the belt for excessive wear, frayed cords etc.
If any defect is found, replace the drive belt.

NOTICE

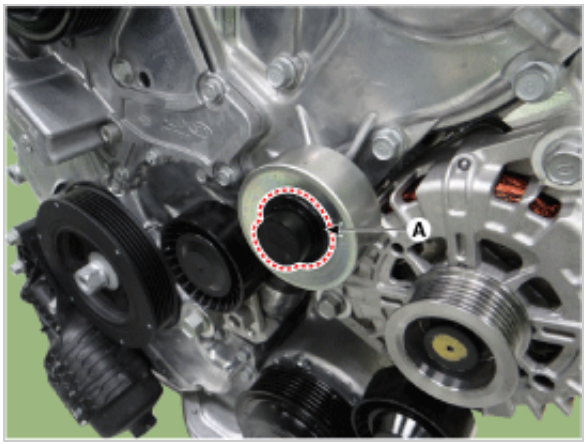
- Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.

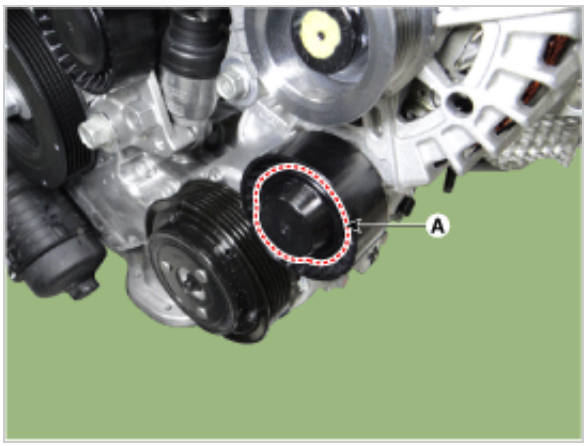


- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

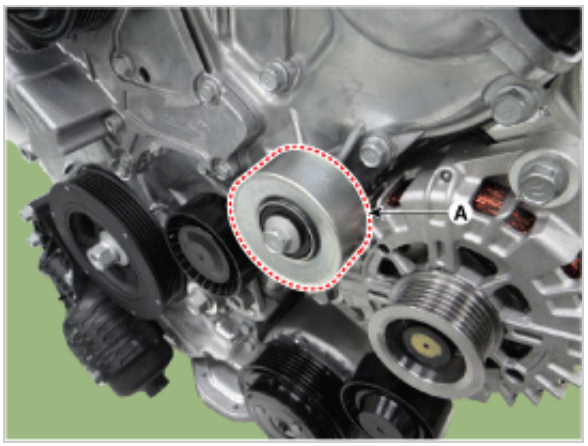
1. Remove the drive belt.
   (Refer to Timing System - "Drive Belt")
2. Remove the idler cap cover (A).

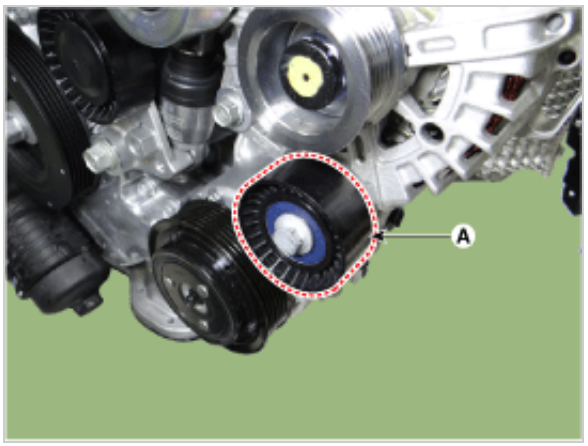




3. Remove the idler (A).

Tightening torque :
53.9 - 57.9 N.m (5.5 - 5.9 kgf.m, 39.8 - 42.7 lb.ft)





4. Install in the reverse order of removal.

- Inspection

Check the idler for excessive oil leakage, abnormal rotation or vibration. Replace if necessary.

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the drive belt.
   (Refer to Timing System - "Drive Belt")
2. Remove the drive belt auto tensioner (A).

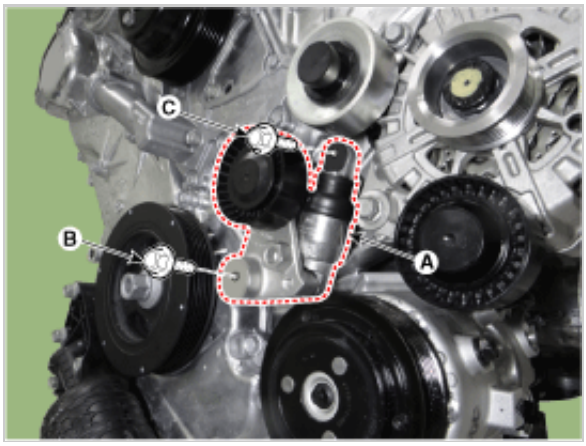
Tightening torque

Bolt (B) :

81.4 - 85.3N.m (8.3 - 8.7kgf.m, 60.0 - 62.9lb-ft)

Bolt (C) :

17.7 - 21.6N.m (1.8 - 2.2kgf.m, 13.0 - 15.9lb-ft)



3. Install in the reverse order of removal.

- Inspection

– Check the belt tensioner for excessive dust, crack, and damage. Replace if necessary

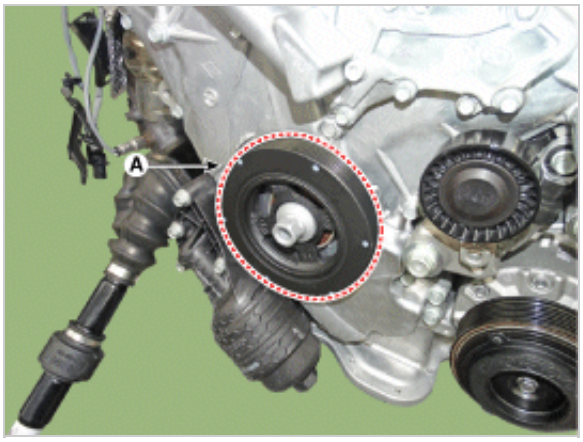
- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Remove the RH side front wheel.
   (Refer to Suspension System - "Wheel")
3. Remove the drive belt.
   (Refer to Timing System - "Drive Belt")
4. Remove the crankshaft damper pulley (A).

Tightening torque :

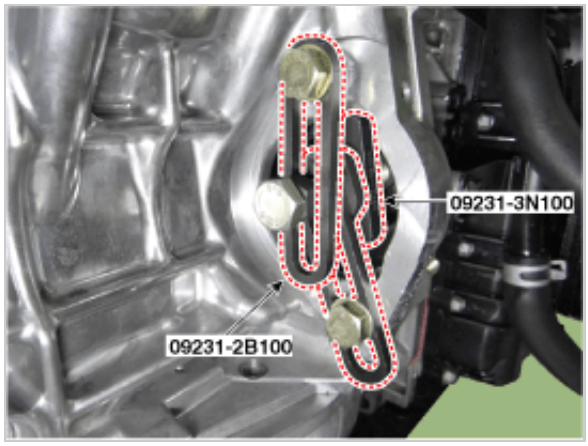
421.7 - 431.5 N.m (43.0 - 44.0 kgf.m, 311.0 - 318.3 lb.ft)



NOTICE

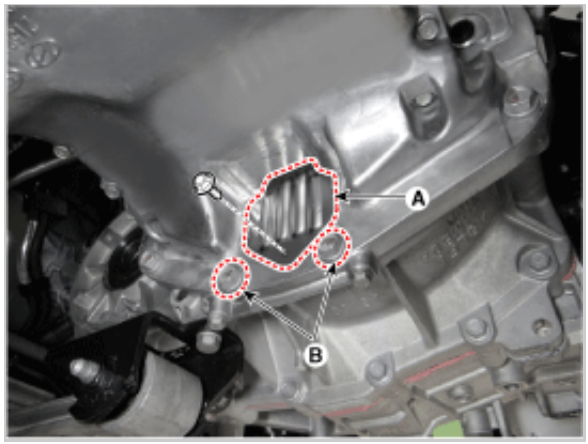
There are two methods to hold the ring gear when installing or removing the crankshaft damper pulley.

- Install the SSTs (09231-2B100, 09231-3N100) to hold the ring gear after removing the starter.

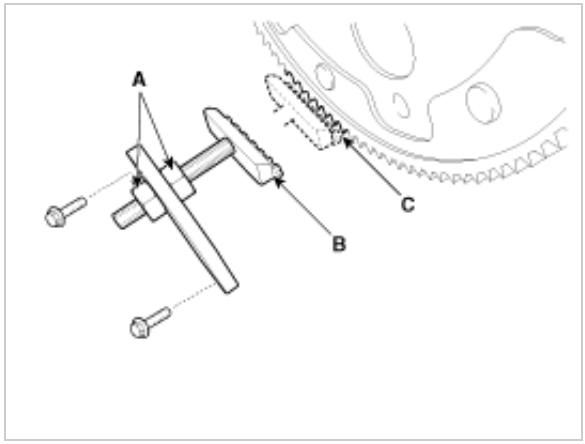


- Install the SSTs (09231-3D100, 09231-2W100) to hold the ring gear after removing the dust cover.

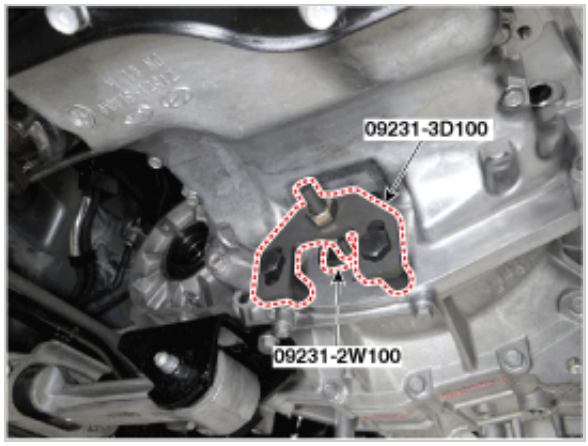
1) Remove the front muffler. [2WD type]
   (Refer to Intake and Exhaust System - "Muffler")
2) Remove the dust cover (A) on the bottom of the upper oil pan and unfasten the two transaxle mounting bolts (B).



3) Adjust the length of the holder nuts (A) so that the front place of the holder (B) matches with the ring gear (C) tooth pattern.
4) Fasten the two transaxle mounting bolts in the original mounted holes.



5) Install the SSTs (09231-3D100, 09231-2W100) using the two mounting bolts. Tighten the bolts and nuts of the holder securely.



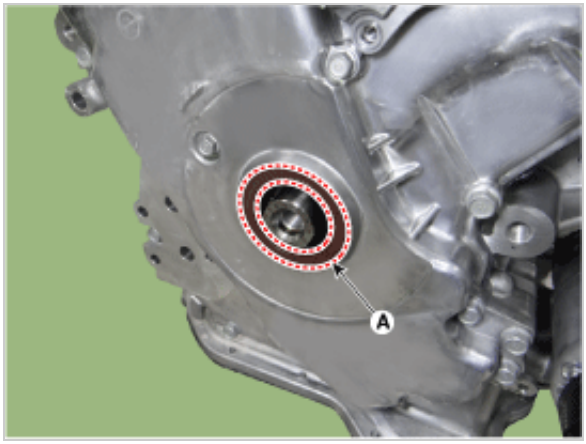
5. Install in the reverse order of removal.

Engine Mechanical System

- Removal

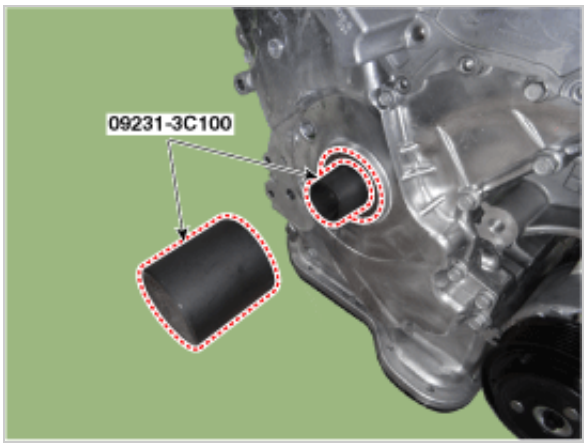
- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the crankshaft damper pulley.
   (Refer to Timing System - "Crankshaft Damper Pulley")
2. Remove the front oil seal (A).



- Installation

1. Using SST(09231-3C100), install front oil seal.



NOTICE

- Always use new oil seal.

2. Install the crankshaft damper pulley.
   (Refer to Timing System - "Crankshaft Damper Pulley")

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

- When removing the high pressure fuel pump, high pressure fuel pipe, delivery pipe, and injector, there is possible risk of injury from leakage of high pressure fuel. Therefore, do not attempt repairing immediately after the engine stops.

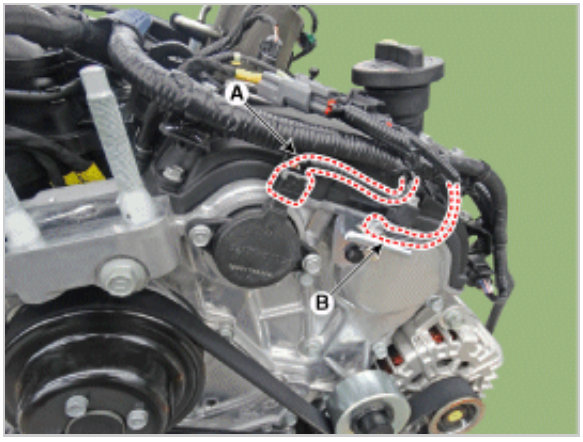
NOTICE

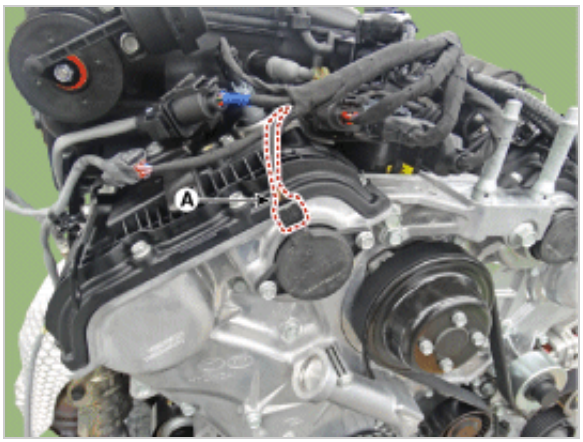
- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.

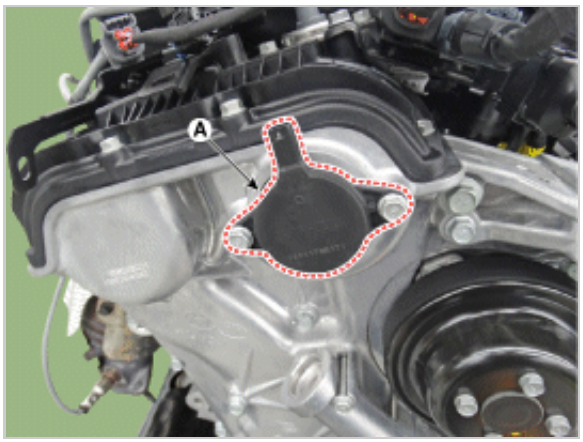
1. Remove the engine cover.
   (Refer to Engine And Transaxle Assembly - "Engine Cover")
2. Remove the engine room under cover.
   (Refer to Engine And Transaxle Assembly - "Engine Room Under Cover")
3. Drain the engine coolant.
   (Refer to Cooling System - "Coolant")
4. Drain the engine oil.
   (Refer to Lubrication System - "Engine Oil")
5. Remove the air cleaner assembly.
   (Refer to Intake And Exhaust System - "Air Cleaner")
6. Disconnect the variable force solenoid (VFS) valve connector (A) and ground cable (B).



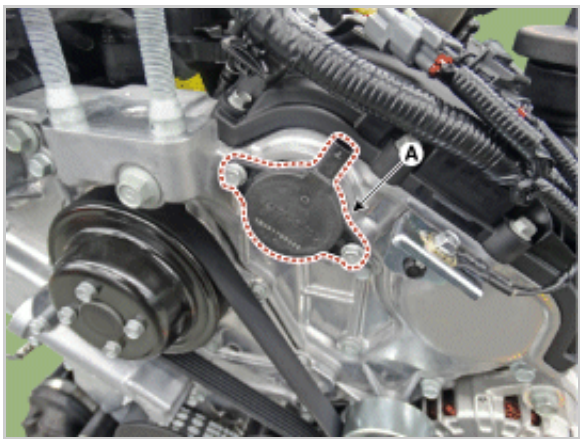


7. Remove the surge tank.
   (Refer to Intake And Exhaust System - "Surge Tank")
8. Remove the LH / RH cylinder head cover.
   (Refer to Cylinder Head Assembly - "Cylinder Head Cover")

9. Remove the drive belt.
   (Refer to Timing System - "Drive Belt")
10. Remove the idler.
   (Refer to Timing System - "Idler")
11. Remove the drive belt tensioner.
   (Refer to Timing System - "Drive Belt Tensioner")
12. Remove the crankshaft damper pulley.
   (Refer to Timing System - "Crankshaft Damper Pulley")
13. Remove the water pump.
   (Refer to Cooling System - "Water Pump")
14. Remove the lower oil pan.
   (Refer to Lubrication System - "Oil Pan")
15. Remove the RH and LH variable force solenoid (VFS) valve (A).
   [RH]



[LH]



> **NOTICE**
> • The variable force solenoid (VFS) must be removed before removing the timing chain cover.

16. Remove the engine mounting support bracket.
   (1) Install the jack to the edge of the upper oil pan to support the engine.

> **NOTICE**
> •

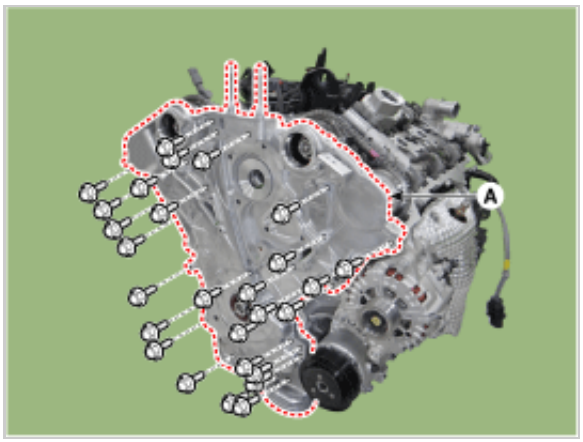
Insert a rubber block between jack and upper oil pan.

(2) Disconnect the engine ground cable (A).

(3) Remove the engine mounting support bracket (A).

Click to see large image...

17. Remove the timing chain cover (A).



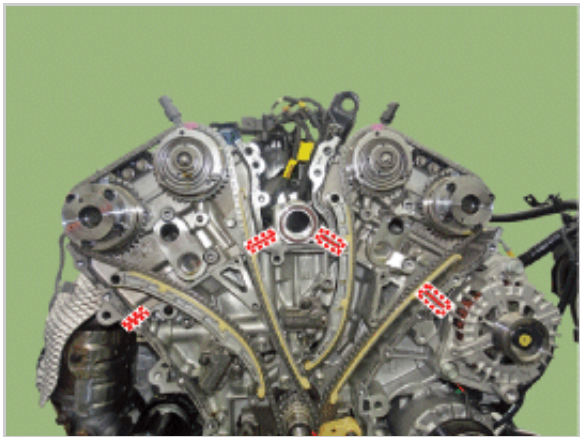
NOTICE

- Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

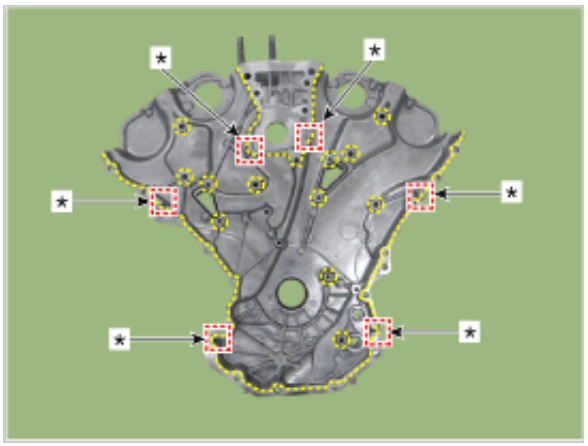
- Installation

1. Install the timing chain cover.
   (1) The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and lower oil pan) must be free of engine oil and etc.
   (2) Before assembling the timing chain cover, apply the liquid sealant TB 1217H on the gap between cylinder head and cylinder block. Assemble the part within 5 minutes of applying sealant.

   Bead width :4.0 mm (0.2 in.)



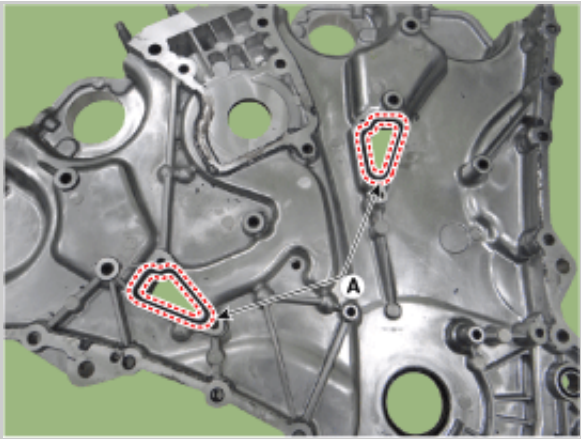
   (3) Apply liquid sealant TB 1217H on timing chain cover. Assemble the part within 5 minutes of applying sealant. Apply sealant in a continuous thread.



NOTICE

- Fill six (6) T-joint areas with sealant.
- Apply sealant all around two (2) dowel pin holes.

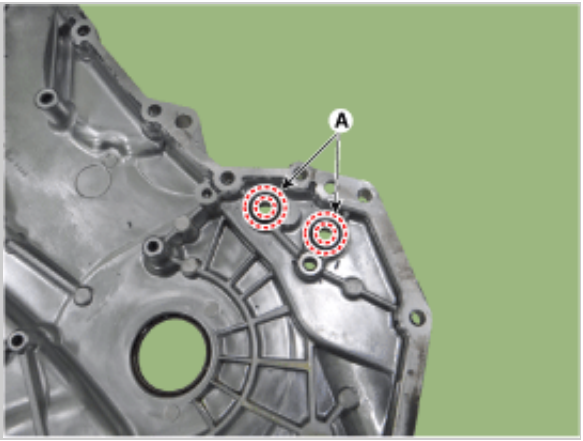
(4) Install the new gasket (A) to the timing chain cover.



NOTICE

- During timing chain cover installation, be careful not to peel off the sealant applied on the timing cover from contact with other parts.

(5) Install the new O-ring (A).



(6) The dowel pins on the cylinder block and holes on the timing chain cover (A) should be used as a reference for assembling the timing chain cover to the exact position.

Tightening torque

A (21 pcs) :

18.6 - 21.6 N.m (1.9 - 2.2 kgf.m, 13.7 - 15.9 lb.ft)

B (2 pcs) :

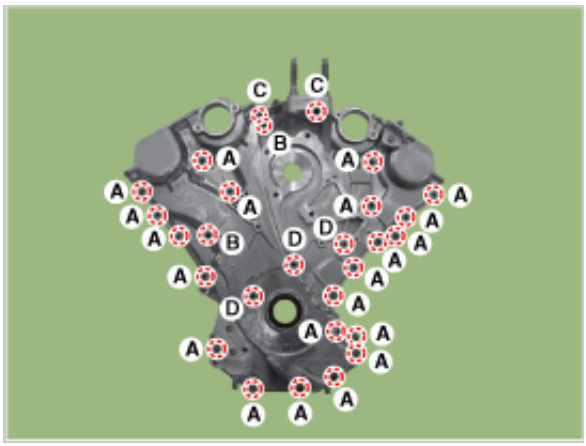
24.5 - 26.5 N.m (2.5 - 2.7 kgf.m, 18.1 - 19.5 lb.ft)

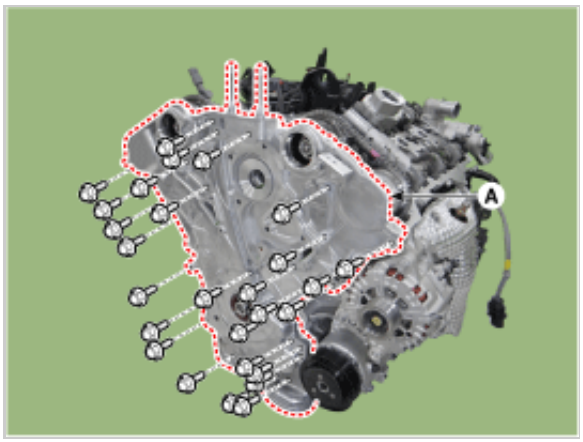
C (2 pcs) :

58.8 - 68.8 N.m (6.0 - 7.0 kgf.m, 43.4 - 50.6 lb.ft)

D (3 pcs) :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)





(7) Do not run the engine or perform pressure test within 30 minutes of assembly.

2. Install the engine mounting support bracket.
   (1) Install the engine mounting support bracket (A).

Tightening torque :
98.1 - 117.7 N.m (10.0 - 12.0 kgf.m, 72.3 - 86.8 lb-ft)

Click to see large image...

(2) Connect the engine ground cable (A).

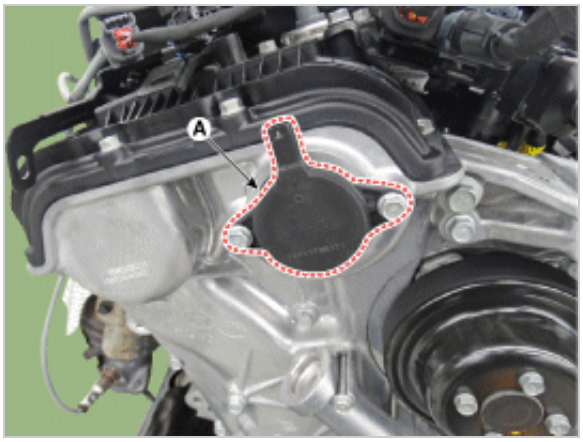
(3) Remove the jack from the upper oil pan.

3. Install the RH and LH variable force solenoid (VFS) valve (A).

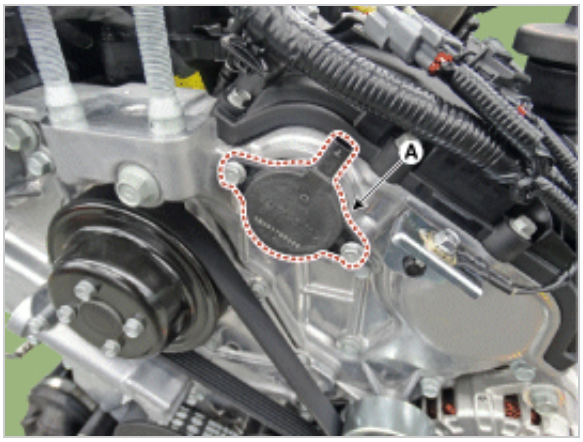
Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

[RH]



[LH]



NOTICE

- Do not use any dropped variable force solenoid (VFS) valve.
- Note below cautions when installing variable force solenoid (VFS) valve.

1) After replacing the O-ring (A) of variable force solenoid (VFS) valve, apply engine oil on new O-ring (A).

2) Push variable force solenoid (VFS) valve up to the timing chain cover, and temporarily tighten the bolt.

3) Tighten the variable force solenoid (VFS) valve to the specified torque.

4. Install the remaining parts in the reverse order of removal.

NOTICE

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.

– After assembling the fuel line, turn on the ignition switch (without operating the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

– Repeat this operation two to three times, and then check for fuel leakage at any point on the fuel lines.

- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.

– Start engine and let it run until it warms up (until the radiator fan operates 3 or 4 times).

– Turn off the engine and let it cool down. Check the level in the radiator, and add coolant if needed. This will allow trapped air to be released from the cooling system.

– Put radiator cap on tightly, then run the engine again and check for leaks.

- Removal

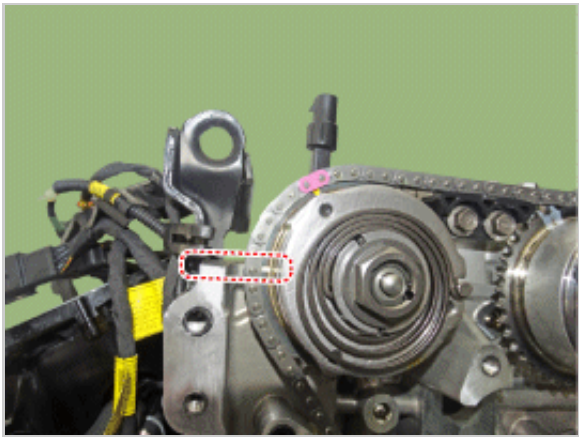
- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Set No.1 cylinder to TDC/compression.
   (1) Turn the crankshaft damper pulley clockwise and align its groove with the timing mark "T" of the lower timing chain cover.

Click to see large image...

(2) Check that the mark of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft clockwise one revolution (360°).

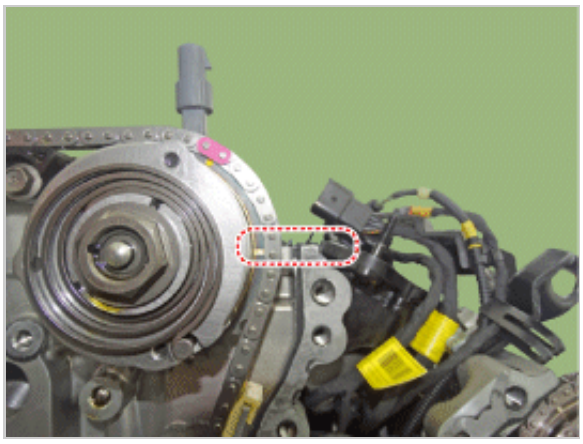
[LH intake]



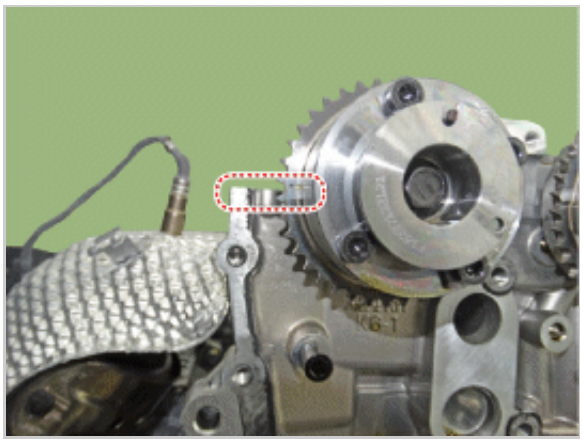
[LH exhaust]

Click to see large image...

[RH intake]



[RH exhaust]



NOTICE

- Do not rotate engine counterclockwise.

2. Remove the timing chain cover.
   (Refer to Timing System - "Timing Chain Cover")

NOTICE

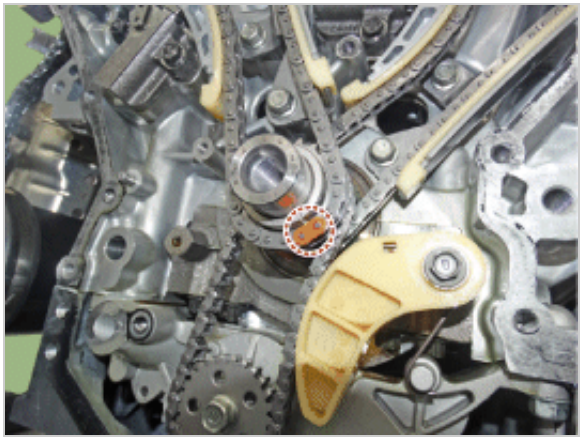
- Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

NOTICE

- Before removing the timing chain, mark the RH/LH timing chain with an identification based on the location of the sprocket because the identification mark on the chain for TDC (Top Dead Center) can be erased.

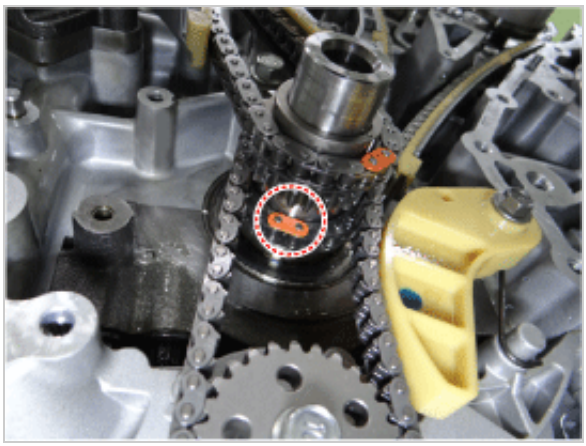
[RH]

Click to see large image...



[LH]

Click to see large image...



3. Release the ratchet by pulling the link down using a thin rod. Compress the piston and then insert a stopper pin into the hole on the ratchet to hold the compressed piston.

Click to see large image...

4. Remove the RH timing chain cam to cam guide (A).

Click to see large image...

5. Remove the RH timing chain auto tensioner (A) and the RH timing chain tensioner arm (B).

Click to see large image...

6. Remove the RH timing chain guide (A).

Click to see large image...

7. Remove the RH timing chain (A).

Click to see large image...

8. Remove the oil pump chain tensioner assembly (A).

Click to see large image...

9. Remove the crankshaft chain sprocket (A) (RH camshaft drive).

Click to see large image...

10. Remove the oil pump chain sprocket (A) and oil pump chain (B).

Click to see large image...

11. Remove the crankshaft sprocket (A) (Oil pump drive).

Click to see large image...

12. Release the ratchet by pulling the link down using a thin rod. Compress the piston and then insert a stopper pin into the hole on the ratchet to hold the compressed piston.

Click to see large image...

13. Remove the LH timing chain cam to cam guide (A).

Click to see large image...

14. Remove the LH timing chain auto tensioner (A).

Click to see large image...

15. Remove the LH timing chain tensioner arm (A).

Click to see large image...

16. Remove the LH timing chain guide (A).

Click to see large image...

17. Remove the LH timing chain (A).

Click to see large image...

18. Remove the crankshaft chain sprocket (A). (LH camshaft drive).

Click to see large image...

19. Remove the tensioner adapter assembly (A).

Click to see large image...

- Inspection

Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

1. Check the camshaft sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

- Installation

1. The key (A) of crankshaft should be aligned with the timing mark (B) of block. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.

Click to see large image...

2. Install the tensioner adapter assembly (A).

Click to see large image...

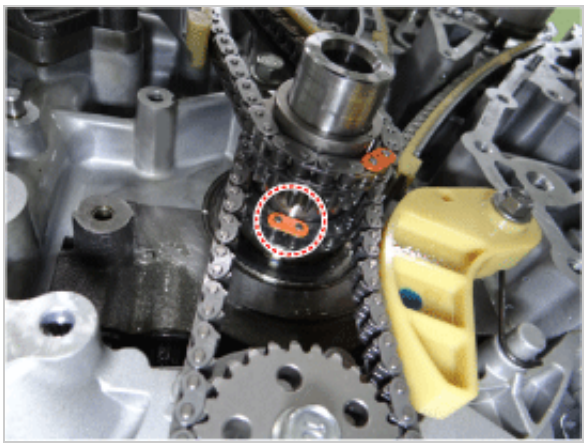
3. Install the crankshaft chain sprocket (A). (LH camshaft drive).

Click to see large image...

4. Install the LH timing chain (A).

Click to see large image...

Click to see large image...



NOTICE

- To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below :
  Crankshaft sprocket → Exhaust camshaft sprocket → Intake camshaft sprocket.
- When installing the timing chain, be sure that the timing mark of each sprocket is matched with the timing mark (color link) of the timing chain.

5. Install the LH timing chain guide (A).

Tightening torque :
19.6 - 24.5 N.m (2.0 - 2.5 kgf.m, 14.5 - 18.1 lb.ft)

Click to see large image...

6. Install the LH timing chain tensioner arm (A).

Tightening torque

18.6 - 21.6 N.m (1.9 - 2.2 kgf.m, 13.7 - 15.9 lb.ft)

Click to see large image...

7. Install the LH timing chain auto tensioner (A).

Tightening torque

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

8. Install the LH timing chain cam to cam guide (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

9. Pull out the pins (A) of LH timing chain auto tensioner.

Click to see large image...

10. Install the crankshaft sprocket (A) (Oil pump drive).

Click to see large image...

11. Install the oil pump chain sprocket (A) and oil pump chain (B).

Tightening torque :
19.6 - 24.5 N.m (2.0 - 2.5 kgf.m, 14.5 - 18.1 lb-ft)

Click to see large image...

12. Install the oil pump chain tensioner assembly (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

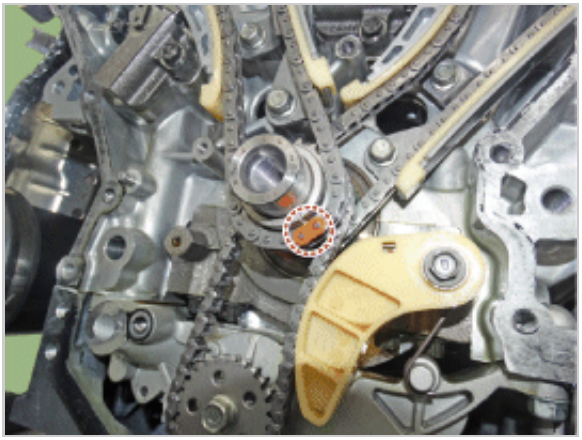
13. Install the camshaft chain sprocket (A). (RH camshaft drive)

Click to see large image...

14. Install the RH timing chain (A).

Click to see large image...

Click to see large image...



NOTICE

- To install the timing chain with no slack between each shaft (cam, crank), follow the procedure below :
  Crankshaft sprocket → Intake camshaft sprocket → Exhaust camshaft sprocket.
- When installing the timing chain, be sure that the timing mark of each sprocket is matched with the timing mark (color link) of the timing chain.

15. Install the RH timing chain guide (A).

Tightening torque

19.6 - 24.5 N.m (2.0 - 2.5 kgf.m, 14.5 - 18.1 lb.ft)

Click to see large image...

16. Install the RH timing chain auto tensioner (A) and the RH timing chain tensioner arm (B).

Tightening torque

A : 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

B : 18.6 - 21.6 N.m (1.9 - 2.2 kgf.m, 13.7 - 15.9 lb.ft)

Click to see large image...

17. Install the RH timing chain cam to cam guide (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

18. Pull out the pins (A) of RH timing chain auto tensioner.

Click to see large image...

19. After rotating the crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm the timing mark.

NOTICE

- Always turn the crankshaft clockwise.
- Turning the crankshaft counterclockwise before building up oil pressure in the hydraulic timing chain tensioner may result in the chain disengagement from the sprocket teeth.

20. Install the timing chain cover.
    (Refer to Timing System - "Timing Chain Cover")

21. Install the remaining parts in the reverse order of removal.

NOTICE

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.

– After assembling the fuel line, turn on the ignition switch (without operating the starter) so that the fuel pump runs for approximately two seconds and fuel line pressureizes.

– Repeat this operation two to three times, and then check for fuel leakage at any point on the fuel lines.

- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.

– Start engine and let it run until it warms up (until the radiator fan operates 3 or 4 times).

– Turn off the engine and let it cool down. Check the level in the radiator, and add coolant if needed. This will allow trapped air to be released from the cooling system.

– Put radiator cap on tightly, then run the engine again and check for leaks.

- Valve Clearance Inspection and Adjustment (MLA)

NOTICE

- Inspect and adjust the valve clearance with engine cold (engine coolant temperature : 20°C (68°F)) and cylinder head installed to the cylinder block.

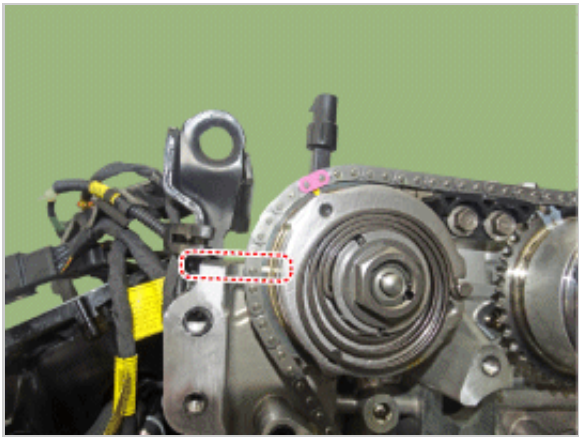
1. Remove the cylinder head cover.
   (Refer to Cylinder Head Assembly - "Cylinder Head Cover")
2. Set No.1 cylinder to TDC / compression.
   (1) Turn the crankshaft damper pulley clockwise and align its groove with the timing mark "T" of the lower timing chain cover.

Click to see large image...

(2) Check that the mark of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration.

If not, turn the crankshaft clockwise one revolution (360°).

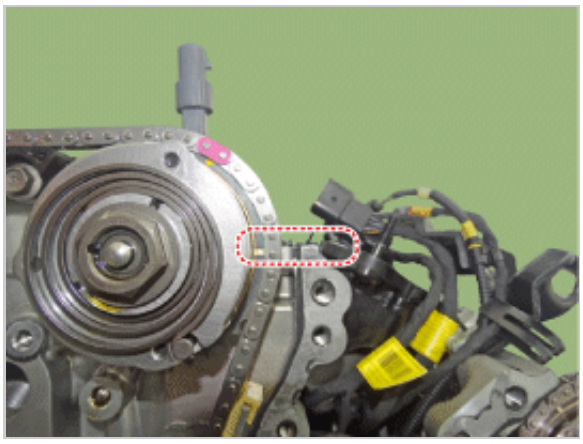
[LH intake]



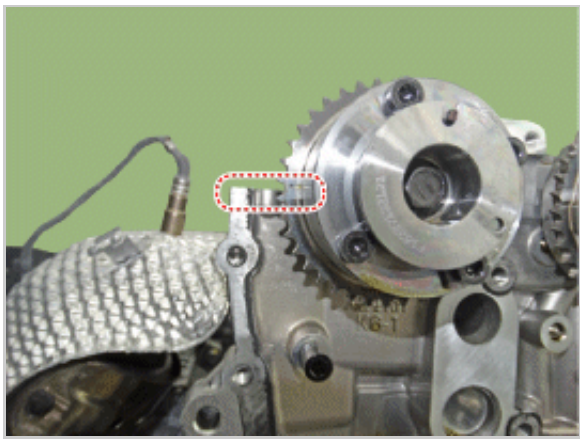
[LH exhaust]

Click to see large image...

[RH intake]



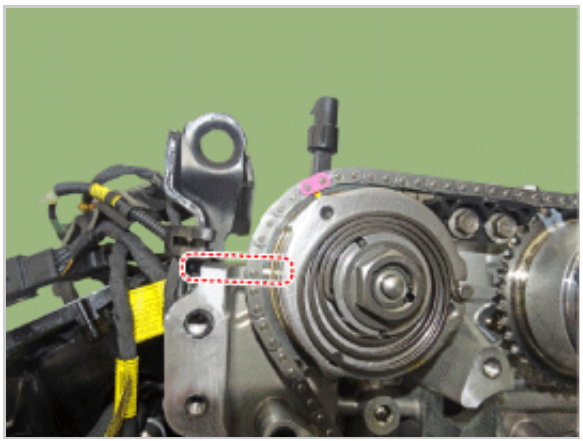
[RH exhaust]



NOTICE

- Do not rotate engine counterclockwise.

3. Inspect the valve clearance.
   (1) With No.1 cylinder at TDC, inspect clearances only for the valves shown below.
   [LH]



Click to see large image...

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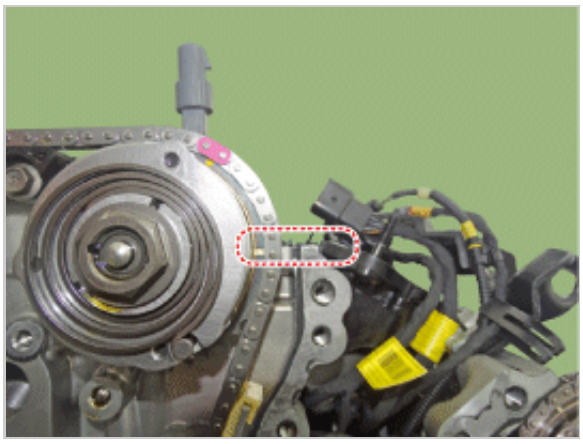
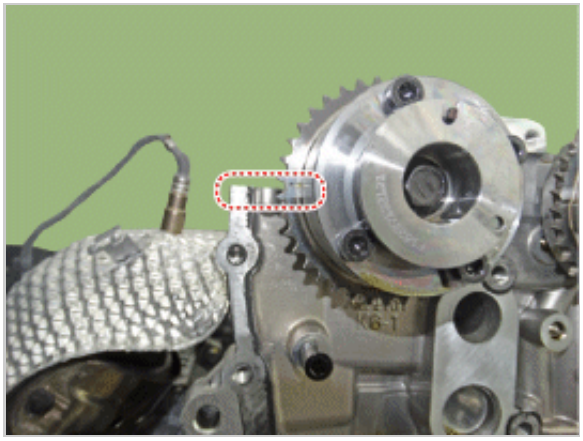
[RH]





Click to see large image...

How to Measure :

a. Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.

b. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting tappet.

Valve clearance (Engine coolant temperature : 20°C [68°F])

[Specification]

Intake : 0.10 - 0.30 mm (0.0039 - 0.0118 in.)

Exhaust : 0.20 - 0.40 mm (0.0079 - 0.0157 in.)

(2) Turn the crankshaft pulley clockwise one revolution (360°) and align the groove with timing mark "T" of the lower timing chain cover.

(3) With the No.4 cylinder at TDC, inspect clearances only for the valves shown in diagram below.
(Refer to procedure step 1.)
[LH]

Click to see large image...

Click to see large image...

[RH]

Click to see large image...

Click to see large image...

4. Adjust the intake and exhaust valve clearance.
   (1) Set the No.1 cylinder to the TDC/compression.
   (2) Remove the camshaft assembly.
   (Refer to Cylinder Head Assembly - "CVVT & Camshaft")
   (3) Remove the tappets.
   (4) Measure the thickness of the removed tappet using a micrometer.

Click to see large image...

(5) Calculate the thickness of a new tappet so that the valve clearance comes within the specified value.

T : Thickness of removed tappet
A : Measured valve clearance
N : Thickness of new tappet
Intake :N = T + [A - 0.20 mm (0.0079 in.)]
Exhaust :N = T + [A - 0.30 mm (0.0118 in.)]

(6) Select a new tappet with a thickness as close as possible to the calculated value.

NOTICE

- Shims are available in 41 size increments of 0.015 mm (0.0006 in.) from 3.00 mm (0.1181 in.) to 3.60 mm (0.1417 in.).

(7) Place a new tappet on the cylinder head.

NOTICE

- Apply engine oil around and on top of selected tappet.

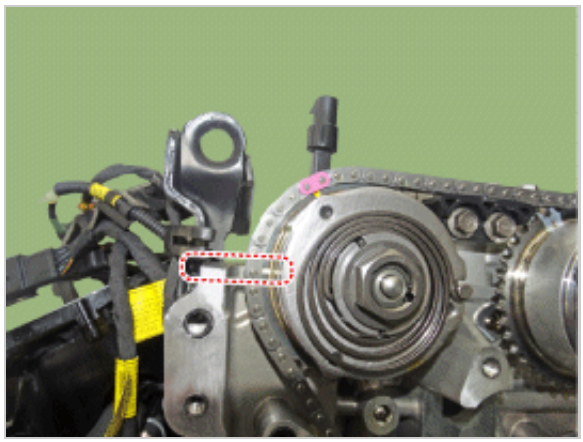
(8) Install the intake and exhaust camshafts.

(9) Install the bearing caps.
(Refer to Cylinder Head Assembly - "CVVT & Camshaft")

(10) Install the timing chain.
(Refer to Timing System - "Timing Chain")

(11) Make two turns on the crankshaft in the operating direction (clockwise) and realign crankshaft sprocket and camshaft sprocket timing marks.

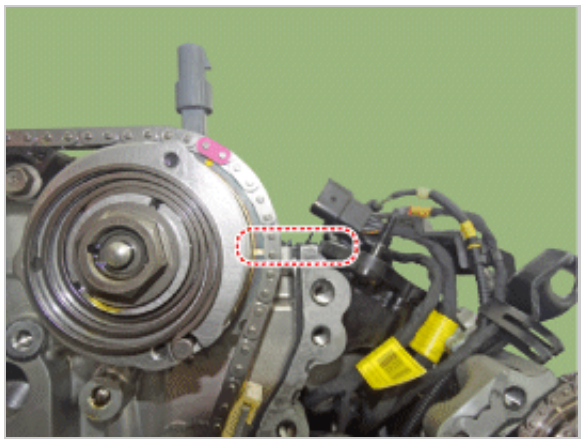
[LH intake]



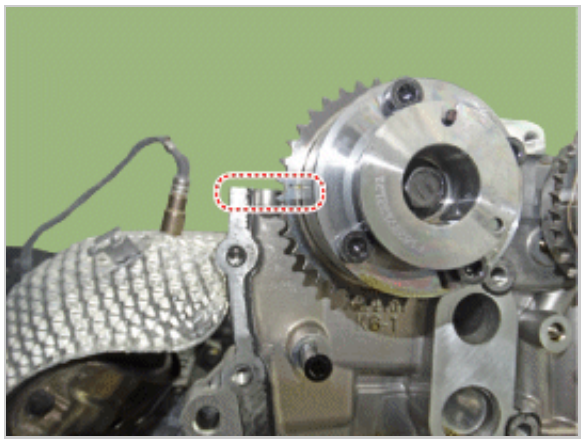
[LH exhaust]

Click to see large image...

[RH intake]



[RH exhaust]



(12) Recheck the valve clearance.

Valve clearance (Engine coolant temperature : 20°C [68°F])

[Specification]

Intake : 0.17 - 0.23 mm (0.0067 - 0.0090 in.)

Exhaust : 0.27 - 0.33 mm (0.0106 - 0.0129 in.)

- Components

Click to see large image...

1. LH cylinder head cover
2. LH cylinder head cover gasket
3. LH exhaust CVVT OCV cap
4. Camshaft position sensor (CMPS)

Click to see large image...

1. RH cylinder head cover
2. RH cylinder head cover gasket
3. RH exhaust CVVT OCV cap
4. Camshaft position sensor (CMPS)

- Removal

[LH Cylinder Head Cover]

1. Remove the engine cover.
   (Refer to Engine And Transaxle Assembly - "Engine Cover")
2. Remove the air cleaner assembly.
   (Refer to Intake And Exhaust System - "Air Cleaner")
3. Disconnect the control wiring harness connectors and fasteners and remove the wiring harness protectors from the LH cylinder head cover.

Click to see large image...

Click to see large image...

Click to see large image...

4. Remove the LH ignition coils.
   (Refer to Engine Electrical System - "Ignition Coil")
5. Remove the high pressure fuel pump.
   (Refer to Engine Control / Fuel System - "High Pressure Fuel Pump")
6. Remove the LH exhaust CVVT oil control valve cap (A).

Click to see large image...

7. Remove the oil level gauge rod mounting bolt.
   (Refer to Lubrication System - "Oil Level Gauge & Pipe")
8. Remove the LH cylinder head cover (A) and gasket.

Click to see large image...

NOTICE

- Cover the cylinder head with a clean shop rag or vinyl cover to prevent foreign materials from entering.

[RH Cylinder Head Cover]

1. Remove the engine cover.
   (Refer to Engine And Transmission Assembly - "Engine Cover")
2. Remove the air cleaner assembly.

(Refer to Intake And Exhaust System - "Air Cleaner")

3. Disconnect the control wiring harness connectors and fasteners and remove the wiring harness protectors from the RH cylinder head cover.

Click to see large image...

Click to see large image...

Click to see large image...

4. Remove the surge tank.
   (Refer to Intake And Exhaust System - "Surge Tank")
5. Remove the RH ignition coils.
   (Refer to Engine Electrical System - "Ignition Coil")
6. Remove the RH exhaust CVVT oil control valve cap (A).

Click to see large image...

7. Remove the RH cylinder head cover (A) and gasket.

Click to see large image...

NOTICE

- Cover the cylinder head with a clean shop rag or vinyl cover to prevent foreign materials from entering.

- Installation

[LH Cylinder Head Cover]

1. Install the new cylinder head cover gasket (A) and high pressure fuel pump gasket (B).

Click to see large image...

2. Install the LH cylinder head cover.

NOTICE

- Install the cylinder head cover with the exhaust OCV cap removed.
- To prevent engine oil leakage, install a new exhaust OCV cap after installing the cylinder head cover.

(1) The hardening sealant on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.

(2) Assemble within 5 minutes of applying the THREE BOND 1217H sealant.

Bead width :4.5 mm (0.2 in.)

Click to see large image...

(3) The firing and / or blow out test should not be performed within 30 minutes of assembling the cylinder head cover.

(4) Install the LH cylinder head cover bolts in the following method.

Tightening torque

1st step : 4.9 - 5.9 N.m (0.5 - 0.6 kgf.m, 3.6 - 4.3 lb.ft)

2nd step : 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Do not reuse cylinder head cover gasket.

3. Install the LH exhaust CVVT oil control valve cap (A).

Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Install the cylinder head cover when the exhaust OCV cap is removed.
- To prevent engine oil leakage, install a new exhaust OCV cap after installing the cylinder head cover.
- If the seal is damaged in the removal and installation procedures, replace the exhaust OCV cap with a new one.

4. Install in the reverse order of removal.

[RH Cylinder Head Cover]

1. Install the new cylinder head cover gasket (A).

Click to see large image...

2. Install the RH cylinder head cover.

NOTICE

- Install the cylinder head cover with the exhaust OCV cap removed.
- To prevent engine oil leakage, install a new exhaust OCV cap after installing the cylinder head cover.

(1) The hardening sealant on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.

(2) Assemble within 5 minutes of applying the THREE BOND 1217H sealant.

Bead width :4.5 mm (0.2 in.)

Click to see large image...

(3) The firing and/or blow out test should not be performed within 30 minutes of assembling the cylinder head cover.

(4) Install the RH cylinder head cover bolts in the following method.

Tightening torque :

1st step: 4.9 - 5.9 N.m (0.5 - 0.6 kgf.m, 3.6 - 4.3 lb.ft)

2nd step: 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Do not reuse cylinder head cover gasket.

3. Install the RH exhaust CVVT oil control valve cap (A).

Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Install the cylinder head cover with the exhaust OCV cap removed.
- To prevent engine oil leakage, install a new exhaust OCV cap after installing the cylinder head cover.
- If the seal is damaged in the removal and installation procedures, replace the exhaust OCV cap with a new one.

4. Install in the reverse order of removal.

- Components

Click to see large image...

1. RH exhaust CVVT
2. RH intake CVVT
3. LH intake CVVT
4. LH exhaust CVVT

- Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consists of

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or takes out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- the CVVT Oil Temperature Sensor (OTS) which measures the engine oil temperature,
- and the Cam Phaser which changes the cam phase by using the hydraulic force of the engine oil.

The engine oil which is supplied from the CVVT oil control valve changes the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.

Click to see large image...

[Intermediate Lock CVVT]

It increases the retarded amount compared to the default state to expand the operating range of the variable valve timing system. The cam phase is fixed mechanically so that it is locked at the middle position.

Click to see large image...

Click to see large image...

Default position: Middle

CVVT operates in advanced / retarded directions.

▷Effect

Improves fuel efficiency by approx. 1.7%.

Expands the intake CVVT operating range.

(Increases the retarded amount by up to 30° compared to the default state.)

∇

LIVC (Late Intake Valve Close)

∇

1. Improves fuel efficiency by reducing pumping loss.
2. Improves knocking characteristics by reducing compression ratio.

- Operation Principle

The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the advance or retard chamber in accordance with the CVVT oil control valve control.

Information

- The variable force solenoid (VFS) changes its force depending on the PWM duty to control the stroke of the OCV.
- It also controls the lock, unlock, advanced, retarded, and holding functions.

1. Intake CVVT

Click to see large image...

2. Exhaust CVVT

Click to see large image...

[CVVT System Mode]

Click to see large image...

(1) Low Speed / Low Load	(2) Part Load

Click to see large image...	Click to see large image...
(3) Low Speed / High Load	(4) High Speed / High Load
Click to see large image...	Click to see large image...

Driving Condition	Exhaust Valve		Intake Valve	
	Valve Timing	Effect	Valve Timing	Effect
(1) Low Speed /Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap * Improvement of combustion stability
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss
(3) Low Speed /High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Improvement of volumetric efficiency)
(4) High Speed /High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency

- Removal

• Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
(Refer to General Information - "Lift and Support Points")

LH CVVT & Camshaft

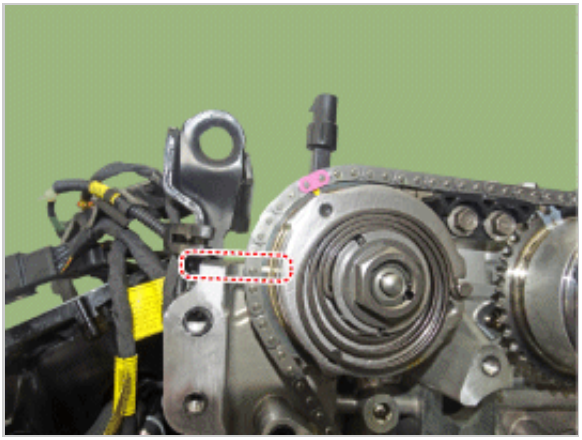
1. Set No.1 cylinder to TDC (Top dead center) on compression stroke.
   (1) Turn the crankshaft damper pulley clockwise and align its groove with the timing mark "T" of the lower timing chain cover.

Click to see large image...

(2) Remove the LH cylinder head cover.
(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

(3) Check that the mark of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft clockwise one revolution (360°).

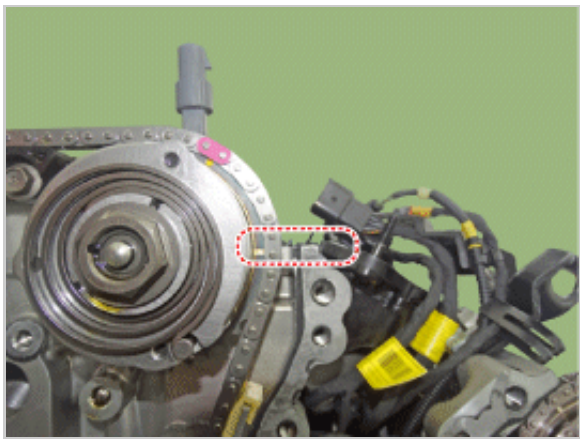
[LH intake]



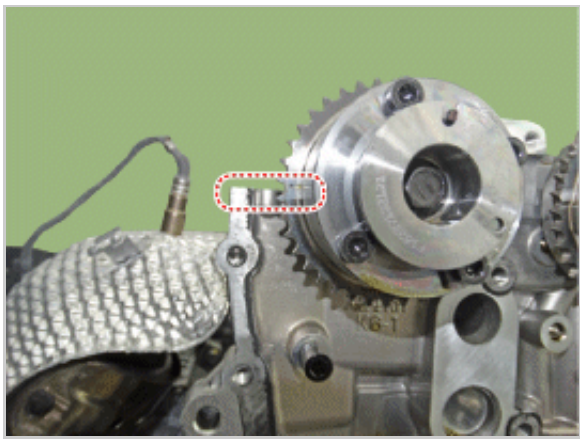
[LH exhaust]

Click to see large image...

[RH intake]



[RH exhaust]



2. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
3. Remove the fuel pump bracket (A)

Click to see large image...

4. Remove the LH exhaust camshaft oil control valve (OCV) (A).

Click to see large image...

5. Remove the LH intake CVVT assembly (A) and exhaust CVVT assembly (B).

Click to see large image...

NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When removing the CVVT assembly bolt, place a wrench at position (A) to prevent the camshaft from rotating.

Click to see large image...

6. Remove the LH camshaft bearing cap (A) and thrust bearing cap (B).

Click to see large image...

7. Remove the LH intake camshaft (A) and exhaust camshaft (B).

Click to see large image...

RH CVVT & Camshaft

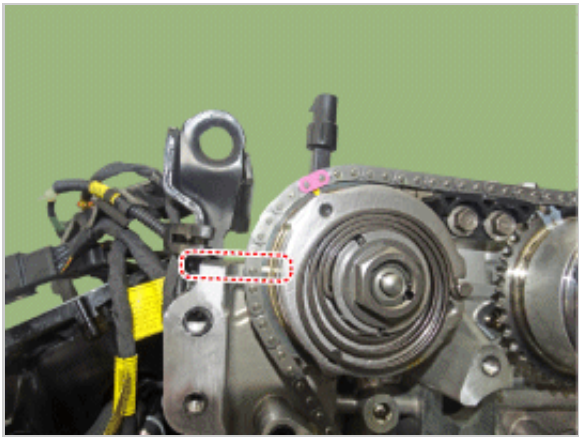
1. Set No.1 cylinder to TDC (Top dead center) on compression stroke.
   (1) Turn the crankshaft damper pulley clockwise and align its groove with the timing mark "T" of the lower timing chain cover.

Click to see large image...

(2) Remove the RH cylinder head cover.
(Refer to Cylinder Head Assembly - "Cylinder Head Cover")

(3) Check that the mark of the camshaft timing sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft clockwise one revolution (360°).

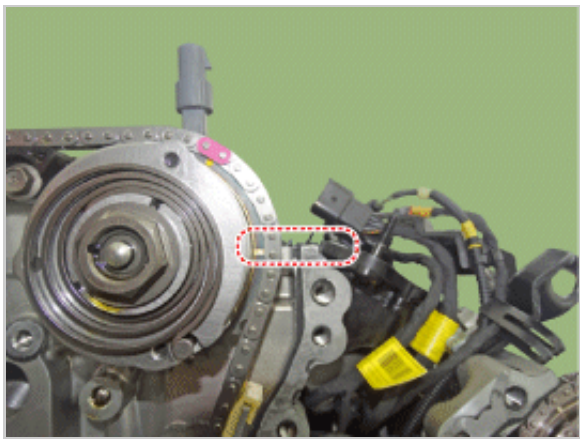
[LH intake]



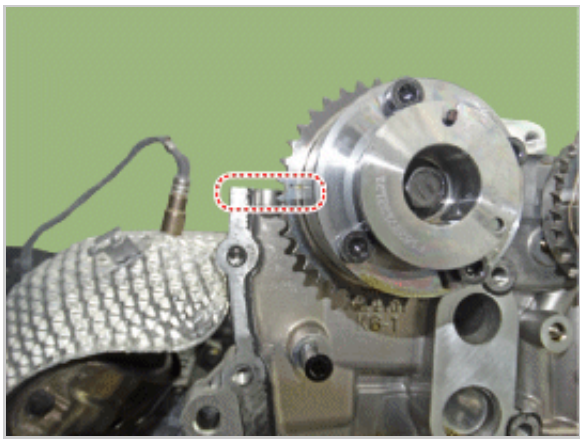
[LH exhaust]

Click to see large image...

[RH intake]



[RH exhaust]



2. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
3. Remove the RH exhaust camshaft oil control valve (OCV) (A).

Click to see large image...

4. Remove the RH intake CVVT assembly (A) and exhaust CVVT assembly (B).

Click to see large image...

NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When removing the CVVT assembly bolt, place a wrench at position (A) to prevent the camshaft from rotating.

Click to see large image...

5. Remove the RH camshaft bearing cap (A) and thrust bearing cap (B).

Click to see large image...

6. Remove the RH intake camshaft (A) and exhaust camshaft (B).

Click to see large image...

- Inspection

Continuous Variable Valve Timing (CVVT) Assembly

1. Inspect the exhaust CVVT for smooth rotation.
   (1) Clamp the camshaft using a vise. Be careful not to damage the cam lobes and journals in the vise.
   (2) Check that the exhaust CVVT is locked by turning it clockwise or counterclockwise. It must not rotate.
   (3) Intake CVVT : Seal one of the two advance holes in the camshaft journal with tape.
   Exhaust CVVT : Seal one of the two retard holes in the camshaft journal with tape.

[Exhaust]

Click to see large image...

(4) Exhaust CVVT : Apply approx. 150 kPa (1.5 kgf/㎠, 21 psi) of compressed air into the unsealed advance hole to release the lock.

Information

- Cover the oil paths with a piece of cloth when applying compressed air to prevent oil from spraying.

(5) With compressed air applied, rotate the exhaust CVVT into the retard direction (clockwise) and check that the CVVT turns smoothly.

Exhaust CVVT phasing range

25˚± 0˚30’ (from the most retarded position to the most advanced position)

Click to see large image...

(6) Rotate the exhaust CVVT into the most advanced position (counterclockwise) and then check that the CVVT is locked.

Camshaft

1. Inspect cam lobes.
   Using a micrometer, measure the cam lobe height.

   Cam height

   [Standard value]

   Intake : 47.2 mm (1.858 in.)

Exhaust : 45.8 mm (1.803 in.)

Click to see large image...

If the cam lobe height is below specification, replace the camshaft.

2. Inspect the camshaft journal clearance.
   (1) Clean the bearing caps and camshaft journals.
   (2) Place the camshafts on the cylinder head.
   (3) Lay a strip of plastigage across each of the camshaft journals.

Click to see large image...

(4) Install the bearing cap (A) and thrust bearing cap (B) to the specified torque.

Tightening torque

1st step : 5.8 N.m (0.6 kgf.m, 4.3 lb.ft)

2nd step : 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

Click to see large image...

NOTICE

- Do not turn the camshaft.

(5) Remove the bearing caps.

(6) Measure the plastigage at its widest point.

Bearing oil clearance

[Standard value]

Intake

No.1 journal : 0.037 - 0.067 mm (0.0015 - 0.0026 in.)

No.2,3,4 journal : 0.030 - 0.067 mm (0.0012 - 0.0026 in.)
Exhaust
No.1 journal : 0.027 - 0.057 mm (0.0010 - 0.0022 in.)
No.2,3,4 journal : 0.030 - 0.067 mm (0.0012 - 0.0026 in.)

Click to see large image...

- If the oil clearance is greater than specification, replace the camshaft.
- If the oil clearance is still over the specification after replacing the camshaft, replace the bearing caps and cylinder head as an assembly.

(7) Completely remove the plastigage.

(8) Remove the camshafts.

3. Inspect the camshaft end play.
   (1) Install the camshafts.
   (2) Install the bearing cap (A) and thrust bearing cap (B) to the specified torque.

Tightening torque

1st step : 5.8 N.m (0.6 kgf.m, 4.31 lb.ft)
2st step : 9.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

Click to see large image...

(3) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value] :

Intake : 0.04 - 0.18 mm (0.0016 - 0.0071 in.)

Exhaust : 0.02 - 0.18 mm (0.0008 - 0.0071 in.)

Click to see large image...

Click to see large image...

- If the end play is greater than specification, replace the camshaft.
- If the end play is still over the specification after replacing the camshaft, replace the bearing caps and cylinder head as an assembly.

(4) Remove the camshafts.

- Installation

NOTICE

- Apply a light coat of engine oil on camshaft journals.
- Assemble the key groove of camshaft rear side to the same level of head top surface.

• Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

Intake camshaft

Click to see large image...

As for camshaft identification (A, B, C, D, E), refer to the table below.

Displacement	Outer diameter	
	LH	RH
	- D : 24 mm (0.9449 in)	A : 30 mm (1.1811 in.)
		B : 30mm (1.1811in)

Intake camshaft	- E : 24mm (0.9449 in)	C : 27mm (1.0630 in)
		D : 27mm (1.0630 in)
		E : 30 mm (1.1811 in.)

Exhaust camshaft

Click to see large image...

As for camshaft identification (A, B, C, D), refer to the table below.

Displacement	Outer diameter

	LH	RH
Exhaust camshaft	A : 27 mm (1.0630 in.)	A : 27 mm (1.0630 in.)
	B : 27 mm (1.0630 in.)	B : 27 mm (1.0630 in.)
	C : 30 mm (1.1811 in.)	C : 30 mm (1.1811 in.)
	D : 27 mm (1.0630 in.)	D : 30 mm (1.1811 in.)

LH CVVT & Camshaft

1. Install the LH intake camshaft (A) and exhaust camshaft (B).

Click to see large image...

2. Install the LH camshaft bearing cap (A) and thrust bearing cap (B) with specified torque.

Tightening torque

1st step :

5.8 N.m (0.6 kgf.m, 4.3 lb.ft)

2nd step :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Be sure to install the thrust bearing cap bolts and the bearing cap bolts in the correct place.
- Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

Click to see large image...

A : L (LH), R (RH)

B : I (Intake), E (Exhaust)

C : Journal number

D : Front mark

- Rotate the crankshaft until the pistons are located 10mm (0.3937in.) below the top of cylinder block so that it doesn't come into contact with the valves.

3. Install the LH intake CVVT assembly (A) and exhaust CVVT assembly (B).

Tightening torque

Intake : 24.5 N.m (2.5 kgf.m, 18.1 lb.ft) + 55 - 61°

Exhaust : 64.7 - 76.5 N.m (6.6 - 7.8 kgf.m, 47.7 - 56.4 lb.ft)

Click to see large image...

NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When installing intake OCV & center bolt, temporarily install by hand, and then fully install by using a tool.
- When installing intake OCV & center bolt, install to the specified tightening torque.
- Do not use any dropped intake OCV & center bolt.
- When installing intake CVVT, apply engine oil on cross section (A) of OCV.

Click to see large image...

- When installing CVVT assembly bolt, hold A section of camshaft with a wrench.
- Be careful not to damage cylinder head and camshaft.

Click to see large image...

- Install camshaft-inlet to dowel pin of CVVT assembly.
  When doing this, be careful not to install on the oil hole of camshaft-inlet.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when installing the camshaft to the dowel pin of CVVT assembly.

4. Install the LH exhaust camshaft oil control valve (OCV) (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

5. Install the fuel pump bracket (A).

Tightening torque :

18.6 - 23.5 N.m (1.9 - 2.4 kgf.m, 13.7 - 17.4 lb.ft)

Click to see large image...

6. Install in the reverse order of removal.

RH CVVT & Camshaft

1. Install the RH intake camshaft (A) and exhaust camshaft (B).

Click to see large image...

2. Install the RH camshaft bearing cap (A) and thrust bearing cap (B) to the specified torque.

Tightening torque

1st step : 5.8 N.m (0.6 kgf.m, 4.3 lb.ft)

2nd step :9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Be sure to install the thrust bearing cap bolts and the bearing cap bolts in the correct place.
- Be cautious not to damage the right and left banks, and intake and exhaust sides when assembling.

Click to see large image...

A : L (LH), R (RH)

B : I (Intake), E (Exhaust)

C : Journal number

D : Front mark

- Rotate the crankshaft until the pistons are located 10mm (0.3937in.) below the top of cylinder block so that it doesn't come into contact with the valves.

3. Install the RH intake CVVT assembly (A) and exhaust CVVT assembly (B).

Tightening torque

Intake : 24.5 N.m (2.5 kgf.m, 18.1 lb.ft) + 55 - 61°

Exhaust : 64.7 - 76.5 N.m (6.6 - 7.8 kgf.m, 47.7 - 56.4 lb.ft)

Click to see large image...

NOTICE

- To prevent impurities from entering intake OCV & center bolt, wear rubber gloves.
- When installing intake OCV & center bolt, temporarily install by hand, and then fully install by using a tool.
- When installing intake OCV & center bolt, install to the specified tightening torque.
- Do not use any dropped intake OCV & center bolt.
- When installing intake CVVT, apply engine oil on cross section (A) of OCV.

Click to see large image...

- When installing CVVT assembly bolt, hold A section of camshaft with a wrench.
- Be careful not to damage cylinder head and camshaft.

Click to see large image...

- Install camshaft-inlet to dowel pin of CVVT assembly.
  When doing this, be careful not to install on the oil hole of camshaft-inlet.
- Hold the hexagonal head wrench portion of the camshaft with a vise, and install the bolt and CVVT assembly.
- Do not rotate CVVT assembly when installing the camshaft to the dowel pin of CVVT assembly.

4. Install the RH exhaust camshaft oil control valve (OCV) (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

5. Install in the reverse order of removal.

- Components

Click to see large image...

1. RH intake camshaft OCV
2. Camshaft thrust bearing cap
3. Camshaft bearing cap
4. RH exhaust camshaft
5. RH intake camshaft
6. RH exhaust camshaft CVVT assembly
7. RH intake camshaft CVVT assembly
8. LH exhaust camshaft OCV
9. LH intake camshaft
10. LH exhaust camshaft
11. LH intake camshaft CVVT assembly
12. LH exhaust camshaft CVVT assembly
13. RH cylinder head
14. Fuel pump bracket
15. LH cylinder head
16. RH cylinder head gasket
17. LH cylinder head gasket
18. MLA
19. Retainer lock
20. Retainer
21. Valve spring
22. Valve stem seal
23. Valve

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, be careful not to fold the gasket or damage the contacting surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

[RH Cylinder Head]

1. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
2. Remove the battery.
   (Refer to Engine Electrical System - "Battery")
3. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
4. Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System - "Air Cleaner")
5. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
6. Drain the engine coolant.
   (Refer to Cooling System - "Coolant")
7. Disconnect the radiator upper hose (A).

Click to see large image...

8. Disconnect the radiator lower hose (A).

Click to see large image...

9. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
10. Remove the intake manifold.
    (Refer to Intake and Exhaust System - "Intake Manifold")
11. Remove the RH exhaust manifold.
    (Refer to Intake and Exhaust System - "Exhaust Manifold")
12. Remove the RH cylinder head cover.
    (Refer to Cylinder Head Assembly - "Cylinder Head Cover")

13. Remove the timing chain.
    (Refer to Timing System - "Timing Chain")
14. Remove the water temperature control assembly.
    (Refer to Cooling System - "Water Temperature Control Assembly")
15. Remove the RH camshaft.
    (Refer to Cylinder Head Assembly - "CVVT & Camshaft")
16. Remove the delivery pipe.
    (Refer to Engine Control / Fuel System - "Delivery Pipe")
17. Remove the RH cylinder head.
    (1) Remove the RH cylinder head rear bolt (A).

Click to see large image...

(2) Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.

Click to see large image...

NOTICE

- Removing bolts in an incorrect order may result in head warpage or crack.

(3) Lift the RH cylinder head (A) from the dowels on the cylinder block and place the cylinder head on wooden blocks of a bench.

Click to see large image...

NOTICE

- Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

(4) Remove the RH cylinder head gasket.

Click to see large image...

[LH Cylinder Head]

1. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
2. Remove the battery.
   (Refer to Engine Electrical System - "Battery")
3. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
4. Remove the air cleaner assembly.

(Refer to Intake and Exhaust System - "Air Cleaner")

5. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
6. Drain the engine coolant.
   (Refer to Cooling System - "Coolant")
7. Disconnect the radiator upper hose (A).

Click to see large image...

8. Disconnect the radiator lower hose (A).

Click to see large image...

9. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
10. Remove the intake manifold.
    (Refer to Intake and Exhaust System - "Intake Manifold")
11. Remove the LH exhaust manifold.
    (Refer to Intake and Exhaust System - "Exhaust Manifold")
12. Remove the alternator.
    (Refer to Engine Electrical System - "Alternator")

13. Remove the LH cylinder head cover.
    (Refer to Cylinder Head Assembly - "Cylinder Head Cover")
14. Remove the timing chain.
    (Refer to Timing System - "Timing Chain")
15. Remove the water temperature control assembly.
    (Refer to Cooling System - "Water Temperature Control Assembly")
16. Remove the LH camshaft.
    (Refer to Cylinder Head Assembly - "CVVT & Camshaft")
17. Remove the delivery pipe.
    (Refer to Engine Control / Fuel System - "Delivery Pipe")
18. Remove the LH cylinder head.
    (1) Uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence shown.

Click to see large image...

NOTICE

- Removing bolts in an incorrect order may result in head warpage or crack.

(2) Lift the LH cylinder head (A) from the dowels on the cylinder block and place the cylinder head on wooden blocks of a bench.

Click to see large image...

NOTICE

- Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

(3) Remove the LH cylinder head gasket.

Click to see large image...

- Disassembly

NOTICE

- Identify MLA, valves and valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove the MLAs (A).

Click to see large image...

2. Remove the valves.
   (1) Using the SSTs (09222-3K000, 09222-3K100), compress the valve spring and remove retainer lock.

Click to see large image...

(2) Remove the spring retainer.

(3) Remove the valve spring.

(4) Remove the valve.

(5) Using the SST (09222-29000), remove the valve stem seal.

Click to see large image...

NOTICE

- Do not reuse old valve stem seals.

- Inspection

Cylinder Head

1. Inspect for flatness.
   Using a precision straight edge and feeler gauge, measure the warpage of the surface contacting with the cylinder block

Flatness of cylinder head gasket surface

Standard : Less than 0.05 mm (0.002 in.)
[Less than 0.02 mm(0.0008 in.) / 150x150]

Flatness of manifold gasket surface

Standard : Less than 0.01 mm (0.004 in) / 110x110

Click to see large image...

2. Inspect for cracks.
   Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

Valve And Valve Spring

1. Inspect valve stems and valve guides.
   (1) Using a caliper gauge, measure the inside diameter of the valve guide.

Valve guide I.D.

Intake / Exhaust : 5.500 - 5.512 mm (0.216 - 0.217 in.)

Click to see large image...

   (2) Using a micrometer, measure the diameter of the valve stem.

Valve stem O.D.

Intake : 5.465 - 5.480 mm (0.2151 - 0.2157 in.)

Exhaust : 5.458 - 5.470 mm (0.2149 - 0.2153 in.)

Click to see large image...

(3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance

[Standard]

Intake : 0.020 - 0.047 mm (0.0008 - 0.0018 in.)

Exhaust : 0.030 - 0.054 mm (0.0012 - 0.0021 in.)

2. Inspect valves.

(1) Check that the valve is ground to the correct valve face angle.

(2) Check the surface of the valve for wear.

If the valve face is worn, replace the valve.

(3) Check the valve head margin thickness.

If the margin thickness is below specification, replace the valve.

Margin

[Standard]

Intake : 1.0 mm (0.0394 in.)

Exhaust : 1.1 mm (0.0433 in.)

Click to see large image...

(4) Check the valve length.

Length

Intake : 105.27 mm (4.1445 in.)

Exhaust : 105.50 mm (4.1535 in.)

(5) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, replace the valve.

3. Inspect valve seats

Check the valve seat for evidence of overheating and improper contact with the valve face.

If the valve seat is worn, replace cylinder head.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace cylinder head. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

4. Inspect valve springs.

(1) Using a steel square, measure the out-of-square of the valve spring.

(2) Using vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 46.2 mm (1.8188 in)

Out-of-square : 1.5˚

Click to see large image...

MLA

1. Inspect MLAs.
   Using a micrometer, measure the MLA outer diameter.

   MLA O.D.
   Intake/Exhaust :
   34.964 - 34.980 mm (1.3765 - 1.3771 in.)

2. Using a caliper gauge, measure MLA tappet bore inner diameter of cylinder head.

   Tappet bore I.D.
   Intake/Exhaust :

35.000 - 35.025 mm (1.3779 - 1.3789 in.)

3. Subtract MLA outer diameter measurement from tappet bore inner diameter measurement.

MLA to tappet bore clearance

[Standard]

Intake/Exhaust : 0.020 - 0.061 mm (0.0008 - 0.0024 in.)

- Reassembly

NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace oil seals with new ones.

1. Install the valves.

(1) Using the SST (09222-3C100), push in a new oil seal.

NOTICE

- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

Click to see large image...

(2) Install the valve, valve spring and spring retainer.

NOTICE

- Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then install the retainer.

(3) Using the SSTs (09222 - 3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are in place before releasing the valve spring compressor.

Click to see large image...

(4) Lightly tap the end of each valve stem two or three times with a soft hammer or the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.

2. Install the MLAs (A).

   Check by hand that the MLA rotates smoothly.

Click to see large image...

NOTICE

- MLA can be reinstalled in its original position.
  However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block.
  Refer to General information in EM section for Valve Clearance checking and adjustment procedure.

- Installation

NOTICE

- Thoroughly clean all parts to be assembled.
- Always use a new head and manifold gasket.
- Always use new cylinder head bolts. Cylinder head bolts are torque-to-yield bolts designed to be permanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail tomaintain clamping force.
- The cylinder head gasket is a metal gasket. Be careful not to bend it.
- Rotate the crankshaft, and set the No.1 piston at TDC.

[RH Cylinder Head]

1. Install the cylinder RH head.
   a. The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
   b. Apply TB 1217H sealant on cylinder block top face before assembling cylinder head gaskets.
      Assemble the part within 5 minutes of applying sealant.

Click to see large image...

NOTICE

- Apply sealant by referring to the following illustration.

Bead width :

2.0 - 3.0 mm (0.078 - 0.118 in.)

Sealant locations :

1.0 - 1.5 mm (0.039 - 0.059 in.) from block surface

Recommended sealant :TB 1217H Liquid sealant

Click to see large image...

c. Apply TB 1217H sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block. Assemble the part within 5 minutes of applying sealant.

Click to see large image...

Click to see large image...

NOTICE

- Be fully aware of the installation direction.

Click to see large image...

d. Install the RH cylinder head (A).

NOTICE

- Remove the extruded sealant after assembling cylinder heads.

Click to see large image...

2. Install the RH cylinder head bolts.

(1) Do not apply engine oil on the threads and under the heads of the cylinder head bolts.

(2) Install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

NOTICE

- Always use new cylinder head bolts. Cylinder head bolts are torque-to-yield bolts designed to be permanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail tomaintain clamping force.

Tightening torque

Head bolt :

37.3 - 41.2 N.m (3.8 - 4.2 kgf.m, 27.5 - 30.4 lb.ft) + (118 - 122°) + (88 - 92°)
Bolt (A) :
18.6 - 23.5 N.m (1.9 - 2.4 kgf.m, 13.7 - 17.4 lb.ft)

Click to see large image...

Click to see large image...

3. Install the remaining parts in the reverse order of removal.

NOTICE

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.

– After assembling the fuel line, turn on the ignition switch (without operating the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

– Repeat this operation two to three times, and then check for fuel leakage at any point on the fuel lines.

- Refill radiator and reservoir tank with engine coolant.

- Bleed air from the cooling system.

– Start engine and let it run until it warms up (until the radiator fan operates 3 to 4 times).

– Turn off the engine and let it cool down. Check the level in the radiator, and add coolant if needed. This will allow trapped air to be released from the cooling system.

– Put radiator cap on tightly, then run the engine again and check for leaks.

[LH Cylinder Head]

1. Install the cylinder LH head.
   a. The sealant locations on cylinder head and cylinder block must be free of engine oil and ETC.
   b. Apply TB 1217H sealant on cylinder block top face before assembling cylinder head gaskets.
      Assemble the part within 5 minutes of applying sealant.

Click to see large image...

NOTICE

- Apply sealant by referring to the following illustration.

Bead width :

2.0 - 3.0 mm (0.078 - 0.118 in.)

Sealant locations :

1.0 - 1.5 mm (0.039 - 0.059 in.) from block surface

Recommended sealant :TB 1217H (Hyundai Gray RTV) Liquid sealant

Click to see large image...

c. Apply TB 1217H sealant on cylinder head gaskets after assembling cylinder head gaskets on cylinder block. Assemble the part within 5 minutes of applying sealant.

Click to see large image...

Click to see large image...

NOTICE

- Be fully aware of the installation direction.

Click to see large image...

d. Install the LH cylinder head (A).

NOTICE

- Remove the extruded sealant after assembling cylinder heads.

Click to see large image...

2. Install the LH cylinder head bolts.

(1) Do not apply engine oil on the threads and under the heads of the cylinder head bolts.

(2) Install and tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

NOTICE

- Always use new cylinder head bolts. Cylinder head bolts are torque-to-yield bolts designed to be permanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail tomaintain clamping force.

Tightening torque

Head bolt :

37.3 - 41.2 N.m (3.8 - 4.2 kgf.m, 27.5 - 30.4 lb.ft) + (118 - 122°) + (88 - 92°)

Click to see large image...

3. Install the remaining parts in the reverse order of removal.

NOTICE

- Refill engine oil.
- Clean the battery posts and cable terminals with sandpaper. Assemble and then apply grease to prevent corrosion.
- Inspect for fuel leakage.

– After assembling the fuel line, turn on the ignition switch (without operating the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

– Repeat this operation two to three times, and then check for fuel leakage at any point on the fuel lines.

- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.

– Start engine and let it run until it warms up (until the radiator fan operates 3 to 4 times).
– Turn off the engine and let it cool down. Check the level in the radiator, and add coolant if needed. This will allow trapped air to be released from the cooling system.
– Put radiator cap on tightly, then run the engine again and check for leaks.

- Components

Click to see large image...

1. Cylinder block
2. Oil cover
3. Oil cover gasket
4. Water jacket separator #1
5. Water jacket separator #2
6. Rear oil seal case
7. Rear oil seal
8. Drive plate
9. Crankshaft upper bearing
10. Thrust bearing
11. Crankshaft
12. Crankshaft lower bearing
13. Main bearing cap
14. Baffle plate

Click to see large image...

1. Piston ring (#1)
2. Piston ring (#2)
3. Oil ring
4. Snap ring
5. Piston
6. Piston pin
7. Connecting rod
8. Connecting rod upper bearing
9. Connecting rod lower bearing
10. Connecting rod bearing cap

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the LH / RH cylinder head assembly and gasket.
   (Refer to Cylinder Head Assembly - "Cylinder Head")
2. Remove the water jacket separator #1 (A), #2 (B).

Click to see large image...

- Installation

1. Install the water jacket separator #1 (A), #2 (B).

Click to see large image...

NOTICE

- Insert the separator by aligning it with the block inner side protrusion. It must be below the cylinder head installing surface.

Click to see large image...

Click to see large image...

2. Install the LH / RH cylinder head assembly and gasket.
   (Refer to Cylinder Head Assembly - "Cylinder Head")

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the automatic transaxle.
   (Refer to Automatic Transaxle System - "Automatic Transaxle")
2. Remove the adapter plate (B) and the drive plate (A).

Tightening torque :
71.6 - 75.5 N.m (7.3 - 7.7 kgf.m, 52.8 - 55.7 lb.ft)

Click to see large image...

3. Install in the reverse order of removal.

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the transaxle assembly.
   (Refer to Automatic Transaxle System - "Automatic Transaxle")
2. Remove the drive plate.
   (Refer to Cylinder Block - "Drive Plate")
3. Remove the rear oil seal (A).

Click to see large image...

4. Remove the rear oil seal case (A).

Click to see large image...

- Installation

1. Install the rear oil seal case (A).

Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant
- Before assembling rear oil seal case, the liquid sealant TB1217H should be applied to the rear oil seal case.
- Assemble the parts within 5 minutes of applying sealant.
- Apply sealant to the inner threads of the bolt holes.

Click to see large image...

2. Using SSTs (09231-3C200, 09231-H1100), install the rear oil seal.

Click to see large image...

NOTICE

- Do not reuse the rear oil seal.

3. Install the remaining parts in the reverse order of removal.

- Disassembly

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing chain before removing the cylinder head.
- Turn the crankshaft damper pulley so that the No.1 piston is at top dead center (TDC).

1. Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly - "Engine And Transaxle Assembly")
2. Remove the transaxle assembly from the engine assembly.
   (Refer to Automatic Transaxle System - "Automatic Transaxle")
3. Remove the drive plate and adapter plate.
   (Refer to Cylinder Block - "Drive Plate")
4. Remove the rear oil seal case.
   (Refer to Cylinder Block - "Rear Oil Seal")
5. Install the engine assembly to engine stand for disassembly.
6. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
7. Remove the intake manifold.
   (Refer to Intake and Exhaust System - "Intake Manifold")
8. Remove the exhaust manifold.
   (Refer to Intake and Exhaust System - "Exhaust Manifold")
9. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
10. Remove the water temperature control assembly.
    (Refer to Cooling System - "Water Temperature Control Assembly")
11. Remove the cylinder head assembly.
    (Refer to Cylinder Head Assembly - "Cylinder Head")
12. Remove the lower oil pan and upper oil pan.
    (Refer to Lubrication System - "Oil Pan")
13. Remove the oil pump.
    (Refer to Lubrication System - "Oil Pump")
14. Remove the oil filter body.
    (Refer to Lubrication System - "Oil filter body")
15. Remove the baffle plate (A).

Click to see large image...

16. Check the connecting rod end play.
17. Check the connecting rod cap oil clearance.
18. Detach the piston and connecting rod assemblies from the cylinder block.
    (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
    (2) Remove the connecting rod bearing cap.

> **Information**
> • Mark the connecting rod, and caps to be able to reassemble in the original position and direction.

(3) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

Information

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.
- Mark the piston and connecting rod assemblies to be able to reassemble in the original position.

19. Disassemble the piston rings.
    (1) Using a piston ring expander, remove the 2 compression rings (A).
    (2) Remove the oil ring and coil spring (B) by hand.

Information

- Arrange the piston rings in the correct order only.

20. Disassemble the connecting rod from the piston.
    (1) Remove the snap ring (C) from the piston.
    (2) Using a press, remove the piston pin (D) from the piston.
    (3) Disassemble the piston (F) and connecting rod (E).

Click to see large image...

- Inspection

Connecting Rod And Crankshaft

1. Check the connecting rod end play.
   Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

Standard end play :
0.1 - 0.25 mm (0.004 - 0.010 in.)

Click to see large image...

- If out-of-tolerance, install a new connecting rod.
- If still out-of-tolerance, replace the crankshaft.

2. Check the connecting rod bearing oil clearance.
   (1) Check that the match marks on the connecting rod and cap are aligned to ensure correct reassembly.
   (2) Remove 2 connecting rod cap bolts.
   (3) Remove the connecting rod cap and bearing half.
   (4) Clean the crank pin and bearing.
   (5) Place plastigage across the crank pin.

(6) Reinstall the bearing half and cap, and torque the bolts.

Tightening torque:

[27.5 - 31.4 N.m (2.8 - 3.2 kgf.m, 20.3 - 23.1 lb.ft)] + [68 - 72°]

Click to see large image...

NOTICE

- Do not turn the crankshaft.
- Always use new connecting rod cap bolts. Connecting rod cap bolts are toque-to-yield bolts designed to be permanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail to maintain clamping force.

(7) Remove 2 bolts, connecting rod cap and bearing half.

(8) Measure the plastigage at its widest point.

Standard oil clearance:

0.042 - 0.060 mm (0.0017 - 0.0024 in.)

Click to see large image...

(9) If the plastigage shows that the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

NOTICE

- Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(10)

If the plastigage shows the clearance is stillincorrect, try the next larger or smaller bearing(the color listed above or below that one), andcheck clearance again.

NOTICE

- If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

NOTICE

- If the marks are indecipherable because of an accumulation of dirt and dust, clean with solvent or detergent instead of scrubbing with a wire brush or scraper.

Connecting Rod Mark Location

Click to see large image...

Identification Of Connecting Rod

Class	Mark	Inside Diameter
0	a	58.000 - 58.006 mm (2.2834 - 2.2837 in.)
1	b	58.006 - 58.012 mm (2.2837 - 2.2839 in.)
2	c	58.012 - 58.018 mm (2.2839 - 2.2842 in.)

Crankshaft Pin Mark Location

Identification Of Crankshaft

Click to see large image...

Identification Of Crankshaft

Class	Mark	Outside Diameter Of Pin
I	1 or A	54.966 - 54.972 mm (2.1640 - 2.1642 in.)
II	2 or B	54.960 - 54.966 mm (2.1638 - 2.1640 in.)
		54.954 - 54.960 mm

III	3 or C	(2.1635 - 2.1638 in.)

Place Of Identification Mark (Connecting Rod Bearing)

Click to see large image...

Identification Of Connecting Rod Bearing

Class	Mark	Thickness Of Bearing
E	Blue	1.509 - 1.512 mm (0.0594 - 0.0595 in.)
D	Black	1.506 - 1.509 mm (0.0592 - 0.0594 in.)
C	Red	1.503 - 1.506 mm (0.0591 - 0.0592 in.)
B	Green	1.500 - 1.503 mm (0.0590 - 0.0591 in.)

A	Yellow	1.497 - 1.500 mm (0.0589 - 0.0590 in.)

(11) Selection

		Connecting Rod Identification Mark		
		0(a)	1(b)	2(c)
Crankshaft Identification Mark	1 or A	A (Yellow)	B (Green)	C (Red)
	2 or B	B (Green)	C (Red)	D (Black)
	3 or C	C (Red)	D (Black)	E (Blue)

3. Check the connecting rod.
   (1) When reinstalling, check the cylinder numbers on the connecting rods and the caps. When installing a new connecting rod, the bearing fixing notches on the connecting rods and caps should face the same direction.
   (2) If one or both edge of the connecting rod thrust surface is damaged, replace the rod. If the inner surface of the rod is damaged or rough, also replace it.
   (3) Using the connecting rod aligner, measure the bending and torsion of the rod. If the measurement is close to the specification, adjust the rod with a press. If the rod is bent or twisted excessively, replace it.

Allowable bending of connecting rod

0.05 mm/100 mm (0.0020 in./3.9370 in.)

Allowable twist of connecting rod

0.1 mm/100 mm (0.0039 in./3.9370 in.)

NOTICE

- When assembling the rod without a bearing, there should be no difference.

Piston

1. Clean piston
   (1) Using a gasket scraper, remove the carbon from the piston top.
   (2) Using a groove cleaning tool, clean the piston ring grooves.
   (3) Using solvent and a brush, thoroughly clean the piston.

NOTICE

- Do not use a wire brush.

2. Check the piston - to - cylinder clearance by calculating the difference between the cylinder bore inner diameter and the piston outer diameter.

Clearance :

0.04 - 0.06 mm (0.0016 - 0.0024 in.)

(1) Using a cylinder bore gauge, measure the cylinder bore diameter in the direction of the thrust and axial.

Standard diameter :

96.00 - 96.03 mm (3.7795 - 3.7807 in.)

Click to see large image...

(2) Measure the piston outside diameter at 14 mm (0.55118 in.) from bottom land of the piston.

Standard diameter :

95.95 - 95.98 mm (3.7776 - 3.7787 in.)

Click to see large image...

3. Select piston by the cylinder bore class.

Clearance :

0.04 - 0.06 mm (0.0016 - 0.0024 in.)

(1) Check the cylinder bore size code on the cylinder block.

Click to see large image...

Identification Of Cylinder Bore

Class	Size code	Cylinder bore inner diameter
A	A	96.00 - 96.01 mm (3.7795 - 3.7799 in.)
B	B	96.01 - 96.02 mm (3.7799 - 3.7803 in.)
C	C	96.02 - 96.03 mm (3.7803 - 3.7807 in.)

(2) Check the piston size code (A) and the front mark (B) on the piston top face.

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Identification of Piston Outer Diameter

Class	Size code	Piston outer diameter
A	A	95.95 - 95.96 mm (3.7776 - 3.7779 in.)
B	B	95.96 - 95.97 mm (3.7779 - 3.7783 in.)
C	C	95.97 - 95.98 mm (3.7783 - 3.7787 in.)

Piston Rings

1. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

Piston ring side clearance

Standard

No.1 : 0.04 - 0.08 mm (0.0015 - 0.0031 in.)

No.2 : 0.04 - 0.08 mm (0.0015 - 0.0031 in.)

Oil ring : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

Limit

No.1 : 0.1 mm (0.004 in.)

No.2 : 0.1 mm (0.004 in.)

Oil ring : 0.2 mm (0.008 in.)

Click to see large image...

If the clearance is greater than maximum, replace the piston.

2. Inspect piston ring end gap.

   To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be replaced.

Piston ring end gap

Standard

No.1 : 0.17 - 0.24 mm (0.0067 - 0.0094 in.)

No.2 : 0.32 - 0.47 mm (0.0126 - 0.0185 in.)

Oil ring :
0.20 - 0.40 mm (0.0078 - 0.0157 in.)
Limit
No.1 : 0.6 mm (0.0236 in.)
No.2 : 0.7 mm (0.0275 in.)
Oil ring : 0.8 mm (0.0315 in.)

Click to see large image...

Piston Pin

1. Measure the diameter of the piston pin.

Piston pin diameter :

21.097 - 22.000 mm (0.8306 - 0.8661 in.)

Click to see large image...

2. Measure the piston pin-to-piston clearance.

Piston pin-to-piston clearance :

0.004 - 0.013 mm (0.00015 - 0.00051 in.)

3. Check the difference between the piston pin diameter and the connecting rod small end diameter.

Piston pin-to-connecting rod interference :

0.005 - 0.019 mm (0.00019 - 0.00074 in.)

- Reassembly

NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

1. Assemble the piston and the connecting rod.
   (1) Install the piston pin with two snap rings and check the snap ring assembly thoroughly.
   (2) The piston front mark (A) and the connecting rod front mark (B) must face the timing belt side of the engine.

Click to see large image...

2. Install the piston rings.
   (1) Install the coil spring and oil ring by hand.
   (2) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
   (3) Position the piston rings so that the ring ends are as shown.

Click to see large image...

3. Install the connecting rod bearings.
   (1) Align the bearing claw with the groove of the connecting rod or connecting rod cap.
   (2) Install the bearings (A) in the connecting rod and connecting rod cap (B).

Click to see large image...

NOTICE

- When reassembling the connecting rods and caps, check the front marks and the number of cylinder.

4. Attach the piston and connecting rod assemblies on the cylinder block.

NOTICE

- Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

(1) Install the ring compressor, and check that the bearing is securely in place. Then, position the piston in the cylinder, and tap it in using the wooden handle of a hammer.

(2) Stop when the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.

(3) Install the rod caps with bearings, and torque the bolts.

Tightening torque:

[27.5 - 31.4 N.m (2.8 - 3.2 kgf.m, 20.3 - 23.1 lb.ft)] + [68 - 72°]

NOTICE

- Always use new connecting rod cap bolts. Connecting rod cap bolts are torque-to-yield bolts designed to be permanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail to maintain clamping force.
- Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

Click to see large image...

5. Install the baffle plate.
   Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown.

Tightening torque:
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

6. Assemble the remaining parts in the reverse order of disassembly.

- Disassembly

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.

(Refer to General Information - "Lift and Support Points")

NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing chain before removing the cylinder head.
- Turn the crankshaft damper pulley so that the No.1 piston is at top dead center (TDC).

1. Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly - "Engine And Transaxle Assembly")
2. Remove the transaxle assembly from the engine assembly.
   (Refer to Automatic Transaxle System - "Automatic Transaxle")
3. Remove the drive plate and adapter plate.
   (Refer to Cylinder Block - "Drive Plate")
4. Remove the rear oil seal case.
   (Refer to Cylinder Block - "Rear Oil Seal")
5. Install the engine assembly to engine stand for disassembly.
6. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
7. Remove the intake manifold.
   (Refer to Intake and Exhaust System - "Intake Manifold")
8. Remove the exhaust manifold.
   (Refer to Intake and Exhaust System - "Exhaust Manifold")
9. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
10. Remove the water temperature control assembly.
    (Refer to Cooling System - "Water Temperature Control Assembly")
11. Remove the cylinder head assembly.
    (Refer to Cylinder Head Assembly - "Cylinder Head")
12. Remove the lower oil pan and upper oil pan.
    (Refer to Lubrication System - "Oil Pan")
13. Remove the oil pump.
    (Refer to Lubrication System - "Oil Pump")
14. Remove the oil filter body.
    (Refer to Lubrication System - "Oil filter body")
15. Remove the baffle plate (A).

Click to see large image...

16. Check the connecting rod end play.
    (Refer to Cylinder Block - "Piston and Connecting Rod")
17. Check the connecting rod cap oil clearance.
    (Refer to Cylinder Block - "Piston and Connecting Rod")
18. Remove the piston and connecting rod assemblies.
    (Refer to Cylinder Block - "Piston and Connecting Rod")
19. Remove the crankshaft main bearing cap and check oil clearance.
20. Check the crankshaft end play.

21. Remove the crankshaft. Lift the crankshaft (A) out of engine, being careful not to damage journals.

Click to see large image...

NOTICE

- Arrange the main bearings and thrust bearings in the correct order.

- Inspection

1. Check the crankshaft bearing oil clearance.
   (1) To check main bearing-to-journal oil clearance, remove the main bearing caps and bearing halves.

(2) Clean each main journal and bearing half with a clean shop towel.

(3) Place one strip of plastigage across each main journal.

(4) Reinstall the bearings and caps, and torque the bolts.

Tightening torque :

No.1 - 8 : 49.0 N.m (5.0 kgf.m, 36.2 lb.ft) + 90°

No.9 - 16 : 19.6 N.m (2.0 kgf.m, 14.5 lb.ft)+ 120°

No.17 - 24 : 29.4 - 31.4 N.m (3.0 - 3.2 kgf.m, 21.7 - 23.1 lb.ft)

Click to see large image...

NOTICE

-

Always use new crankshaft main bearing cap bolts. Crankshaft main bearing cap bolts are torque-to-yield bolts designed to bepermanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail to maintain clamping force.

- Do not turn the crankshaft.

(5) Remove the cap and bearing again, and measure the widest part of the plastigage.

Standard oil clearance :

0.023 - 0.041 mm (0.0009 - 0.0016 in.)

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(6) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

NOTICE

- Do not file, shim, or scrape the bearings or the caps to adjust clearance.

(7) If the plastigage shows that the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

NOTICE

- If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

NOTICE

- If the marks are indecipherable because of an accumulation of dirt and dust, clean with solvent or detergent instead of scrubbing with a wire brush or scraper.

Crankshaft bore mark location

Letters are stamped on the block as a mark for the size of each of the 4 main journal bores.

Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

Click to see large image...

Identification of Cylinder Block

Class	Mark	Inside Diameter
a	A	73.500 - 73.506 mm (2.8937 - 2.8939 in.)
b	B	73.506 - 73.512 mm (2.8939 - 2.8942 in.)
c	C	73.512 - 73.518 mm (2.8942 - 2.8944 in.)

Crankshaft Journal Mark Location

Identification of Crankshaft

Click to see large image...

Identification of Crankshaft

Class	Mark	Outside Diameter of Journal
I	1 or A	68.954 - 68.960 mm (2.7147 - 2.7150 in.)
II	2 or B	68.948 - 68.954 mm (2.7145 - 2.7147 in.)

III	3 or C	68.942 - 68.948 mm (2.7142 - 2.7145 in.)

Place of Identification Mark (Crankshaft Bearing)

Click to see large image...

Identification of Crankshaft Bearing

Class	Mark	Thickness Of Bearing
E	Blue	2.276 - 2.279 mm (0.0896 - 0.0897 in.)
D	Black	2.273 - 2.276 mm (0.0895 - 0.0896 in.)
C	Red	2.270 - 2.273 mm (0.0894 - 0.0895 in.)

B	Green	2.267 - 2.270 mm (0.0893 - 0.0894 in.)
A	Yellow	2.264 - 2.267 mm (0.0891 - 0.0893 in.)

Selection

		Crankshaft Bore Identification Mark		
		a (A)	b (B)	c (C)
Crankshaft Identification Mark	1 or A	A (Yellow)	B (Green)	C (Red)
	2 or B	B (Green)	C (Red)	D (Black)
	3 or C	C (Red)	D (Black)	E (Blue)

2. Check crankshaft end play.
   Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

   Standard end play :
   0.10 - 0.28 mm (0.0039 - 0.0110 in.)

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If the end play is greater than maximum, replace the thrust bearings as a set.

Thrust bearing thickness :

2.41 - 2.45 mm (0.0949 - 0.0964 in.)

3. Inspect main journals and crank pins

   Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter :

68.942 - 68.960 mm (2.7142 - 2.7149 in.)

Crank pin diameter :

54.954 - 54.972 mm (2.1635 - 2.1642 in.)

Click to see large image...

- Reassembly

NOTICE

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

1. Install the main bearings.

NOTICE

- There are oil grooves or oil holes on upper bearings whereas there is none on lower bearings.

(1) Align the bearing claw with the claw groove of the cylinder block, and push in the 4 upper bearings (A).

Click to see large image...

(2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.

2. Install the thrust bearings.

Install the 2 thrust bearings (A) under the No. 3 journal position of the cylinder block with the oil grooves facing outward.

Click to see large image...

3. Place the crankshaft (A) on the cylinder block.

Click to see large image...

4. Place the main bearing caps on cylinder block.
5. Install the main bearing cap bolts.
   (1) Install and uniformly tighten the bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

Main bearing cap bolt

No.1 - 8 : 49.0 N.m (5.0 kgf.m, 36.2 lb.ft) + 90°

No.9 - 16 : 19.6 N.m (2.0 kgf.m, 14.5 lb.ft) + 120°

No.17 - 24 : 29.4 - 31.4 N.m (3.0 - 3.2 kgf.m, 21.7 - 23.1 lb.ft)

Click to see large image...

NOTICE

- Always use new crankshaft main bearing cap bolts. Crankshaft main bearing cap bolts are torque-to-yield bolts designed to bepermanently elongated beyond the state of elasticity when torqued, so if the bolts are removed and reused, it may cause the bolts to break or fail to maintain clamping force.
- If any of the bearing cap bolts are broken or deformed, replace it.

(2) Check that the crankshaft turns smoothly.

6. Check crankshaft end play.
7. Install the piston and connecting rod assemblies.

(Refer to Cylinder Block - "Piston and Connecting Rod")

8. Install the baffle plate.
   Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown.

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

9. Assemble the remaining parts in the reverse order of disassembly.

Information

After replacing the crankshaft with a new one, select the proper connecting rod bearing according to the pin journal mark on the crankshaft.

- Connecting rod bearing selection
  (Refer to Cylinder Block - "Piston and Connecting Rod")

- Disassembly

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

NOTICE

- Use fender covers to avoid damaging painted surfaces.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing chain before removing the cylinder head.
- Turn the crankshaft damper pulley so that the No.1 piston is at top dead center (TDC).

1. Remove the engine assembly from the vehicle.
   (Refer to Engine and Transaxle Assembly - "Engine And Transaxle Assembly")
2. Remove the transaxle assembly from the engine assembly.
   (Refer to Automatic Transaxle System - "Automatic Transaxle")
3. Remove the drive plate and adapter plate.
   (Refer to Cylinder Block - "Drive Plate")
4. Remove the rear oil seal case.
   (Refer to Cylinder Block - "Rear Oil Seal")
5. Install the engine assembly to engine stand for disassembly.
6. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
7. Remove the intake manifold.
   (Refer to Intake and Exhaust System - "Intake Manifold")
8. Remove the exhaust manifold.
   (Refer to Intake and Exhaust System - "Exhaust Manifold")
9. Remove the timing chain.
   (Refer to Timing System - "Timing Chain")
10. Remove the water temperature control assembly.
    (Refer to Cooling System - "Water Temperature Control Assembly")
11. Remove the cylinder head assembly.

(Refer to Cylinder Head Assembly - "Cylinder Head")

12. Remove the lower oil pan and upper oil pan.
    (Refer to Lubrication System - "Oil Pan")
13. Remove the oil pump.
    (Refer to Lubrication System - "Oil Pump")
14. Remove the oil filter body.
    (Refer to Lubrication System - "Oil filter body")
15. Remove the oil cover (A) and gasket (B).

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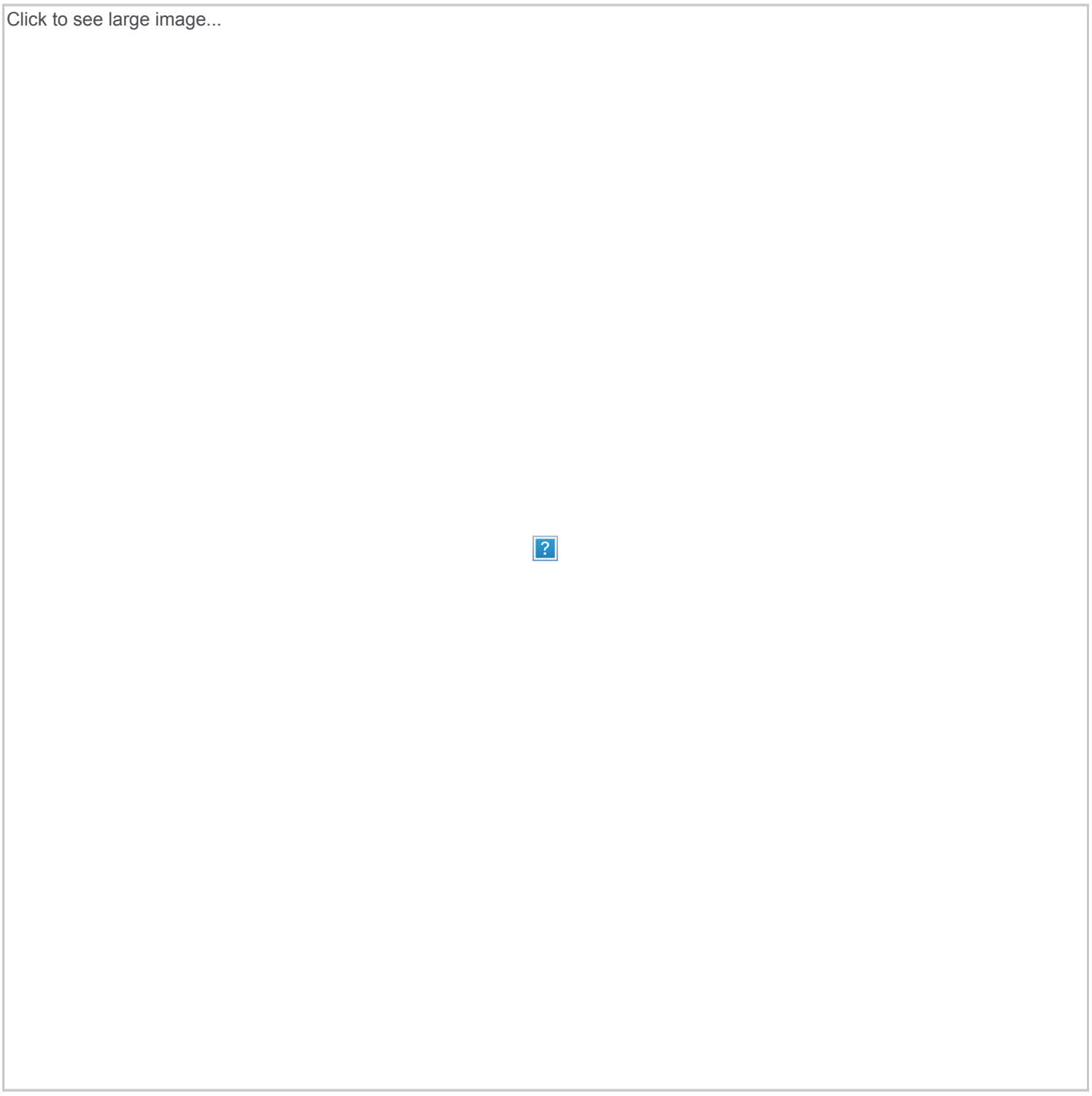

16. Remove the water jacket separator.
    (Refer to Cylinder Block - "Water Jacket Separator")
17. Remove the knock sensor.
    (Refer to Engine Control / Fuel System - "Knock Sensor")
18. Remove the baffle plate (A).

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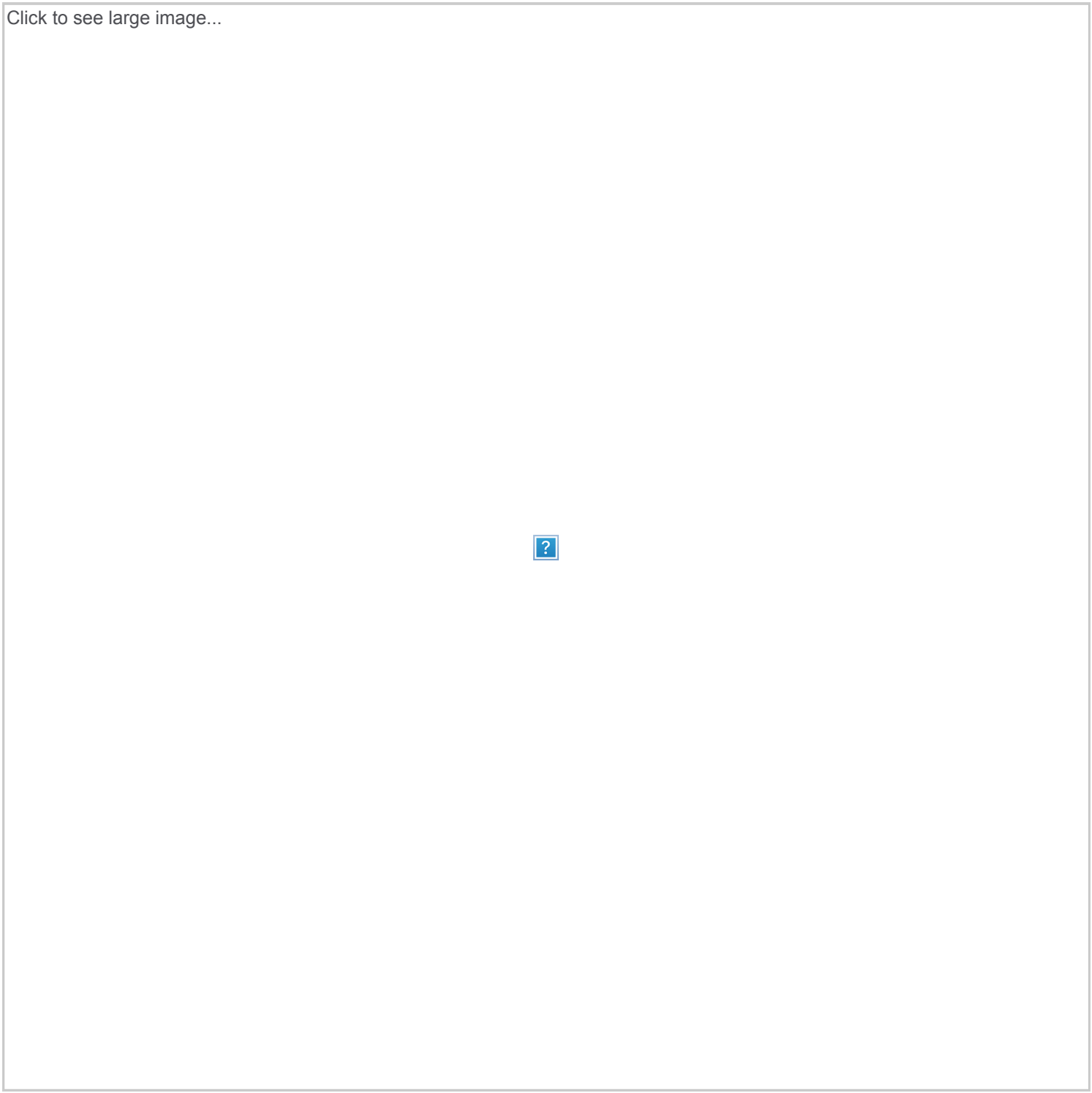


19. Check the connecting rod end play.
    (Refer to Cylinder Block - "Piston and Connecting Rod")
20. Check the connecting rod cap oil clearance.
    (Refer to Cylinder Block - "Piston and Connecting Rod")

21. Remove the piston and connecting rod assemblies.
    (Refer to Cylinder Block - "Piston and Connecting Rod")
22. Remove the crankshaft main bearing cap and check oil clearance.
    (Refer to Cylinder Block - "Crankshaft")
23. Check the crankshaft end play.
    (Refer to Cylinder Block - "Crankshaft")
24. Remove the crankshaft.
    (Refer to Cylinder Block - "Crankshaft")
25. Remove the oil jets (A).

Click to see large image...

- Inspection

Cylinder Block

1. Remove the gasket material.
   Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
2. Clean the cylinder block.
   Using a soft brush and solvent, thoroughly clean the cylinder block.
3. Inspect the top surface of the cylinder block for flatness.

Using a precision straight edge and feeler gauge, measure the warpage of the surface contacting with the cylinder head gasket.

Flatness of cylinder block gasket surface

Standard : Less than 0.05 mm (0.0020 in.),
Less than 0.02 mm (0.0008 in.) / 150 x 150

Click to see large image...

4. Inspect cylinder bore diameter.
   Visually check the cylinder for vertical scratches.
   If deep scratches are present, replace the cylinder block.
5. Inspect cylinder bore diameter
   Using a cylinder bore gauge, measure the cylinder bore diameter in the direction of the thrust and axial.

Measuring position :

10 / 66 / 122mm from top face of cylinder block

Standard diameter :

96.00 - 96.03 mm (3.7795 - 3.7807 in.)

Click to see large image...

6. Check the cylinder bore size code on the cylinder block.

Click to see large image...

Class	Size code	Cylinder bore inner diameter
A	A	96.00 - 96.01 mm (3.7795 - 3.7799 in.)
B	B	96.01 - 96.02 mm (3.7799 - 3.7803 in.)
C	C	96.02 - 96.03 mm (3.7803 - 3.7807 in.)

- Reassembly

1. Install the oil jets (A).

Tightening torque:

27.5 - 31.3 N.m (2.8 - 3.2 kgf.m, 20.2 - 23.1 lb.ft)

Click to see large image...

2. Install the crankshaft.
   (Refer to Cylinder Block - "Crankshaft")
3. Install the crankshaft main bearing cap and check oil clearance.
   (Refer to Cylinder Block - "Crankshaft")
4. Check the crankshaft end play.
   (Refer to Cylinder Block - "Crankshaft")
5. Install the piston and connecting rod assemblies.

(Refer to Cylinder Block - "Piston and Connecting Rod")

6. Check the connecting rod end play.
   (Refer to Cylinder Block - Piston and Connecting Rod")
7. Install the baffle plate.
   Install and uniformly tighten the baffle plate bolts, in several passes, in the sequence shown.

Tightening torque:
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

8. Install the knock sensor.

(Refer to Engine Control / Fuel System - "Knock Sensor")

9. Install the water jacket separator.
   (Refer to Cylinder Block - "Water Jacket Separator")
10. Install the oil cover (A) and gasket (B).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

11. Assemble the remaining parts in the reverse order of disassembly.

Information

After replacing the cylinder block with a new one, select the proper crankshaft main bearing and piston according to the crankshaft journal bore mark and the cylinder bore mark on the cylinder block.

- Crankshaft main bearing selection
  (Refer to Cylinder Block - "Crankshaft")
- Piston selection
  (Refer to Cylinder Block - "Piston and Connecting Rod")

- Engine Overheat Troubleshooting

Inspection		Remedy
Visual inspection	Inspect for shortage of coolant in reservoir tank .	Reinspect after replenishing coolant.
	Inspect for coolant pollution after removing radiator cap. • Be careful when removing radiator cap from overheated vehicle.	Reinspect after replacing coolant.
	Inspect for leakage and loose coolant hoses (radiator hose, heater hose, oil cooler hose, etc.).	Reinspect for leakage after reinstalling hoses and clamps.
	Inspect for leakage on water inlet fitting mounting part.	Reinspect for leakage after replacing O-ring. Reinspect for leakage after tightening to the specified torque.
	Inspect drive belt (for normal operation of water pump).	Adjust drive belt tension or replace.
	Inspect for leakage on water pump gasket mounting part.	Reinspect for leakage after replacing gasket. Reinspect for leakage after tightening to the specified torque.
	Inspect for loose coolant temperature sensor, cooling fan connector and pin.	Reinstall loose connector. Replace relevant part if connector pin is damaged.
	Inspect operation status of cooling fan. - Check operation status by switching ON/OFF the heater control A/C. **Information** • Will not operate in cold ambient temperature.	Check mounting status of ground cable.
Diagnostic device	Inspect self-diagnostic code using GDS.	Check coolant temperature sensor, wiring, connector, etc.
Unit inspection	Inspect water pump impeller.	Replace water pump.
	Inspect for foreign materials and status of thermostat valve.	Inspect unit after removing foreign materials.
	Inspect for stuck thermostat valve. - Immerse thermostat in water heated to over 95°C (203°F), then heat for at least 3 minutes to check valve lift. **NOTICE** •	Check valve lift. - Replace thermostat if valve lift is below specification or valve is stuck.

Do not use water below 95°C (203°F).

- Do not directly heat unit as this will damage thermostat.

- Replacement And Air Bleeding

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

- Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

NOTICE

- When pouring engine coolant, shut the relay box lid and be careful not to spill coolant on the electrical parts or the paint. Rinse off any spilt coolant immediately.

1. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap (A).

Click to see large image...

3. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
4. Loosen the drain plug (A), and drain the coolant.

Click to see large image...

5. Tighten the radiator drain plug securely.
6. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
7. Fill the radiator with water through the radiator cap and tighten the cap.

Information

- To most effectively bleed air, pour water slowly while pressing on the upper / lower radiator hoses..

8. Start the engine and allow it to warm up to normal operating temperature. Wait until the cooling fans turn on 2-3 times. Accelerate the engine to aid in purging trapped air. Shut the engine off.

9. Wait until the engine is cool.
10. Repeat steps 1 to 8 until the drained water runs clear.
11. Fill with fluid mixture of coolant and water (45-60% or 45-50% in North America, Europe and China) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as to bleed air easily.

NOTICE

- Use only the specified antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 45 - 60% minimum. Coolant concentrations less than 45 - 60% may not provide sufficient protection against corrosion or freezing.
- Coolant concentrations greater than 60% will impair cooling efficiency and are not recommended.

- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.

12. Start the engine and run until coolant circulates.
13. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
14. Repeat step 11 until the cooling fan operates 3-5 times to sufficiently bleed air out of the cooling system.
15. Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.
16. Run the vehicle under idle until the cooling fan operates 2-3 times.
17. Stop the engine and wait for the coolant to cool down.
18. Repeat steps 10 to 15 until the coolant level doesn't fall anymore to bleed air out of the cooling system.

Information

- Bleed air out of the cooling system and refill coolant after the coolant has cooled down completely. To do this, recheck the coolant level in the reservoir tank 2-3 days after replacing coolant.

Coolant capacity :

Approx. 11.98 L (3.16 U.S.gal., 12.66 U.S.qt., 10.54 Imp.qt.)

- Components

Click to see large image...

1. Cooling fan
2. Cooling fan motor
3. Cooling fan shroud

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

Cooling Fan Assembly

1. Disconnect the battery negative terminal.
2. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
3. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
4. Drain engine coolant so that its level would be under the radiator upper hose height.
   (Refer to Cooling System - "Coolant")
5. Remove the front bumper cover.
   (Refer to Body (Interior and Exterior) - "Front Bumper Cover")
6. Remove the ambient temperature sensor.
   (Refer to Heating, Ventilation Air conditioning - "Ambient Temperature Sensor")
7. Remove the front bumper beam assembly.
   (Refer to Body (Interior and Exterior) - "Front Bumper Beam Assembly")
8. Remove the intake shield (A).

Click to see large image...

9. Disconnect the wiring connectors and harness clamps around the radiator air guard.

Click to see large image...

10. Remove the radiator air guard (A).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

Click to see large image...

11. Disconnect the wiring harness connector (A).

Click to see large image...

12. Remove the radiator upper mounting brackets (A).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

[LH]

Click to see large image...

[RH]

Click to see large image...

13. Remove the front end module (FEM) bracket (A).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

Click to see large image...

14. Remove the hood latch assembly.
    (Refer to Body (Interior and Exterior) - "Hood Latch Assembly")
15. Remove the radiator upper hose bracket mounting bolt (A).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

Click to see large image...

16. Disconnect the radiator upper hose (A).

Click to see large image...

17. Disconnect the ATF cooler hoses (A).

18. Remove the cooling fan assembly (A).

Tightening torque :
4.9 - 7.8 N.m (0.5 - 0.8 kgf.m, 3.6 - 5.8 lb-ft)

Click to see large image...

19. Install in the reverse order of removal.
20. Fill the radiator with coolant.
    (Refer to Cooling System - "Coolant")
21. Start engine and check for leaks.
22. Recheck the coolant level.

- Disassembly

1. Remove the cooling fan and cooling fan motor (A) from the cooling fan shroud.

Tightening torque :

3.9 - 5.9 N.m (0.4 - 0.6 kgf.m, 2.9 - 4.3 lb-ft)

Click to see large image...

2. Install in the reverse order of disassembly.

- Inspection

1. Turn ignition switch "OFF" and connect the GDS to the Data Link Connector.
2. With the gear shift in P (Park) position and ignistion switch "ON" (LED of the Power button illuminates in Red), select the "force drive" function.

3. Force drive the cooling fan motor.

> **Information**
> • There are two functions for the fan motor force drive: Low speed and high speed.

[Fan motor low speed]

1) Start the "Fan motor low speed" of the force drive function.

Click to see large image...

2) Force drive by pressing the start button.
3) Visually check the operation of the cooling fan.
4) Stop the force drive by pressing the stop button.

Click to see large image...

[Fan motor high speed]

1) Start the "Fan motor high speed" of the force drive function.

Click to see large image...

2) Force drive by pressing the start button.

Click to see large image...

3) Visually check the operation of the cooling fan.

4) Stop the force drive by pressing the stop button.

Click to see large image...

- Components

Click to see large image...

1. Radiator
2. Radiator upper hose
3. Radiator lower hose
4. Radiator upper mounting bracket
5. Radiator lower mounting insulator
6. Radiator air guard

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Drain the engine coolant.
   (Refer to Cooling System - "Cooling Fan")
2. Remove the cooling fan assembly.
   (Refer to Cooling System - "Cooling Fan")
3. Remove the A/C condenser bracket (A).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb-ft)

Click to see large image...

4. Disconnect the radiator lower hose (A).

Click to see large image...

5. Disconnect the over flow hose (A).

Click to see large image...

6. Separate the A/C condenser from the radiator assembly.
7. Remove the radiator assembly (A) from the vehicle.

Click to see large image...

8. Install in the reverse order of removal.
9. Fill the radiator with coolant.
   (Refer to Cooling System - "Coolant")
10. Start engine and check for leaks.
11. Recheck the coolant level.

- Inspection

Radiator Cap Testing

1. Remove the radiator cap, wet its seal with engine coolant, and then install it on a pressure tester.

Click to see large image...

2. Apply a pressure of 93.16 - 122.58 kpa (0.95 - 1.25 kg/cm², 13.51 - 17.78 psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

Radiator Leakage Test

1. Wait for the engine to cool. Carefully remove the radiator cap and fill the radiator with engine coolant. Then, install it on the pressure tester.

2. Apply a pressure tester to the radiator and apply a pressure of 93.16 - 122.58 kpa (0.95 - 1.25 kg/cm², 13.51 - 17.78 psi).

Click to see large image...

3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

NOTICE

- Check for engine oil in the coolant and/or coolant in the engine oil.

- Removal and Installation

1. Disconnect the over flow hose (A).
2. Remove the reservoir tank (B).

Tightening torque :
7.8 - 11.8 N.m (0.8 - 1.2 kgf.m, 5.8 - 8.7 lb.ft)

Click to see large image...

3. Install in the reverse order of removal.

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

NOTICE

- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

Information

- Mark all wiring and hoses to avoid misconnection.

Water Temperature Control Assembly

1. Disconnect the battery negative terminal.
2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the air duct.
   (Refer to Intake and Exhaust System - "Air Cleaner")
4. Disconnect the battery positive terminal.
5. Remove the air cleaner assembly.
   (Refer to Intake and Exhaust System - "Air Cleaner")
6. Remove the battery and battery tray.
   (Refer to Engine Electrical System - "Battery")
7. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
8. Drain the engine coolant.
   (Refer to Cooling System - "Coolant")
9. Disconnect the radiator upper hose (A).

Click to see large image...

10. Disconnect the radiator lower hose (A).

Click to see large image...

11. Disconnect the water temperature sensor connector (A).

Click to see large image...

12. Disconnect the control wiring harness connectors and fasteners and remove the wiring harness protectors from the water temperature control assembly.

Click to see large image...

Click to see large image...

13. Disconnect the heater hoses (A).

14. Disconnect the ATF warmer hose (A).

Click to see large image...

15. Remove the water temperature control assembly (A).

Tightening torque :
24.5 - 28.4 N.m (2.5 - 2.9 kgf.m, 18.1-21.0 lb.ft)

Click to see large image...

16. Remove the water temperature control assembly gasket (A).

[LH]

Click to see large image...

[RH]

Click to see large image...

NOTICE

- Always use new gaskets.

17. Install in the reverse order of removal.
18. Fill the radiator with coolant.
    (Refer to Cooling System - "Coolant")
19. Start engine and check for leaks.
20. Recheck the coolant level.

NOTICE

- Refill engine coolant.
- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.

– Start the engine and let it run until it warms up until the radiator fan operates 3 to 4 times).

– Turn off the engine. Check the level in the radiator, and add coolant if needed. This will release trapped air from the cooling system.

– Put radiator cap on tightly, then run the engine again and check for leaks.

- Before assembling the water temperature control assembly, clean the battery posts and cable terminals with sandpaper and grease the o-ring to prevent corrosion.

Water Center Pipe

1. Remove the water temperature control assembly.
2. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
3. Remove the intake manifold.
   (Refer to Intake and Exhaust System - "Intake Manifold")
4. Remove the water center pipe (A).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

NOTICE

- Do not reuse water pipe O-ring.

5. Install in the reverse order of removal.

- Components

Click to see large image...

1. Water pump pulley
2. Water pump
3. Water pump gasket

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Drain the coolant.
   (Refer to Cooling System - "Coolant")
3. Remove the drive belt.
   (Refer to Timing System - "Drive Belt")
4. Remove the water pump pulley (A).

Click to see large image...

5. Remove the water pump (A) and gaskets.

Click to see large image...

- Inspection

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

NOTICE

- A small amount of seepage from the bleed hole is normal.

Water Pump

1. Install the water pump (A) with new gaskets.

Click to see large image...

NOTICE

- Clean the contacting surface before assembling.
- Always use new gaskets.
- Always use a new seal bolt (Bolt B)

Tightening torque

A (5EA) :9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)

B (1EA) :21.6 - 26.5 N.m (2.2 - 2.7 kgf.m, 15.9 - 19.5 lb-ft) -**(Do not reuse)**

C (4EA) :21.6 - 23.5 N.m (2.2 - 2.4 kgf.m, 15.9 - 17.4 lb-ft)

D (1EA) :9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)

E (1EA) :9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb-ft)

Click to see large image...

2. Install the water pump pulley (A).

Tightening torque :

7.8 - 9.8N.m (0.8 - 1.0kgf.m, 5.8 - 7.2lb.ft)

Click to see large image...

3. Install in the reverse order of removal.
4. Fill the radiator with coolant.
   (Refer to Cooling System - "Coolant")
5. Start engine and check for leaks.
6. Recheck the coolant level.

- Troubleshooting

Trouble Symptom		Probable Cause		Remedy
Coolant leakage	• From the bleed hole of the water pump	Visually check	• Check leaks after about 10 minutes of warming up.	• If coolant still leaks, replace the water pump.
				• If leakage stops, reuse the water pump. (Do not replace the pump with a new one.)
	• From gaskets or bolts		• Check the tightening of the water pump mounting bolts.	• Retighten the mounting bolts.
			• Check damage of gaskets or inflow of dust.	• Replace the gasket and clean dust off.
	• From outer surface of water pump		• Check the material for any cracks of the water pump.	• Material defect. If any cracks are found, replace the water pump.
Noise	• From bearings • From mechanical seals • Impeller interference	Inspection with a stethoscope	• After starting the engine, check noise with a stethoscope.	• If there is no noise, reuse the water pump (do not replace it).
				• If there is any noise from the water pump, remove the drive belt and recheck.
		Inspection after removing the drive belt.	• After removing the water pump and the drive belt, check noise again.	• If there is noise, reuse the water pump. Check other drive line parts.
				• If there is no noise, replace the water pump with a new one.
		Inspection after removing the water pump	• After removing the water pump and the drive belt, check noise again.	• If there is any interference between them, replace the water pump with a new one.
Overheating	• Damaged impeller • Loose impeller	Loose impeller	• Corroded impeller wing	• Check engine coolant. • Poor coolant quality / Maintenance check
			• Impeller seperated from the shaft	• Replace the water pump.

- Description and Operation

Electric Thermostat (ECT)

Overview

Optimal control of coolant temperature depending on the driving conditions

Click to see large image...

Operation Principle

Click to see large image...

Electric Thermostat (ECT) Structure

Click to see large image...

- Removal

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

NOTICE

- Removal of the thermostat may have an adverse effect, causing a reduction in cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

1. Disconnect the battery negative terminal.
2. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
3. Drain engine coolant.
   (Refer to Cooling System - "Coolant")
4. Disconnect the radiator lower hose (A).

Click to see large image...

5. Disconnect the electric thermostat (ECT) connector (A).

Click to see large image...

6. Remove the electric thermostat (ECT) and water inlet fitting assembly (A).

Tightening torque :
16.7 - 19.6 N.m (1.7 - 2.0 kgf.m, 12.3 - 14.5 lb.ft)

Click to see large image...

7. Install in the reverse order of removal.
8. Fill the engine coolant.
   (Refer to Cooling System - "Coolant")
9. Start the engine and check for leaks.
10. Recheck the coolant level.

- Inspection

1. Immerse thermostat in water heated to over 95°C (203°F), then heat for at least 3 minutes to check valve lift.

Click to see large image...

NOTICE

- Do not immerse connector part.

2. Check the valve opening temperature.

Valve opening temperature:
100 ± 2°C (212±3.6°F)
Full opening temperature:113°C (235°F)

If the valve opening temperature is not as specified, replace the thermostat.

3. Check the valve lift.

Valve lift :8 mm (0.3150 in.) or more at 113°C (235°F)

If the valve lift is not as specified, replace the thermostat.

- Troubleshooting

Trouble Symptom		Probable Cause		Remedy
Coolant leakage	• From the thermostat gasket	Check the mounting bolts	• Check the torque of the mounting bolts	• Retighten the bolts and check leakage again.
		Check the gasket for damage	• Check gasket or seal for damage	• Replace gaskets and reuse the thermostat.
Cooled excessively	• Low heater performance (cool air blowed-out) • Thermogauge indicates 'LOW'	Visually check after removing the radiator cap.	• Insufficient coolant or leakage.	• After refilling coolant, recheck.
		Check GDS & engine start	• Check DTCs • Check connection of the fan clutch or the fan motor. ※ If the fan clutch is always connected, there will be a noise at idle.	• Check the engine coolant sensor, wiring and connectors. • Replace the components.
		Remove the thermostat and inspect	• Check if there are dust or chips in the thermostat valve. • Check adherence of the thermostat.	• Clean the thermostat valve and reuse the thermostat. • Replace the thermostat, if it doesn't work properly.
Heated excessively	• Engine overheated • Thermogauge indicates 'HI'	Visually check after removing the radiator cap.	• Insufficient coolant or leakage. ※Be careful when removing the radiator cap of the overheated vehicle. • Check air in cooling system.	• After refilling coolant, recheck. • Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.
		Check GDS & engine start	• Check DTCs • Check the fan motor performance as temperature varies. • Check if the fan clutch slips. • Check for water pump adherence and damaged impeller.	• Check the engine coolant sensor, wiring and connectors. • Check the fan motor, the relay and the connector. • Replace the fan clutch, if it doesn't work properly. • Replace the water pump, if it doesn't work properly.
		Immerse the thermostat in boiling water and inspect.	• After removing the thermostat, check if it works properly. ※ Check the thermostat opens at the valve opening temperature.	• Replace the thermostat, if it doesn't work properly.

- Engine oil flow diagram

Click to see large image...

- Replacement

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.

1. Park the car on level ground.
2. Drain engine oil.
   (1) Remove the oil filler cap.
   (2) Remove the drain under cover (A).

Click to see large image...

(3) After lifting the car, remove the oil drain plug (A) and drain oil into a container.

Click to see large image...

3. Replace the oil filter.
   (1) Remove the oil filter cap (A).

Click to see large image...

(2) Replace the O-ring (A) of oil filter cap with a new one.

Click to see large image...

(3) Replace the new oil filter element (A).

Click to see large image...

(4) Check and clean the oil filter installation surface.

(5) Apply clean engine oil to the new O-rings (A).

Click to see large image...

(6) Lightly screw the oil filter cap into place, and tighten it until the O-ring contacts the seat.

NOTICE

- Check if the o-ring (A) is installed correctly inside the cap.

Click to see large image...

(7) Finally tighten it again to the specified tightening torque.

Tightening torque :

31.4 - 38.2 N.m (3.2 - 3.9 kgf.m, 23.1 - 28.2 lb-ft)

4. Fill new engine oil.

(1) Install the oil drain plug (A) with a new gasket.

Tightening torque :

34.3 - 44.1 N.m (3.5 - 4.5 kgf.m, 25.3 - 32.5 lb.ft)

Click to see large image...

(2) Install the drain under cover (A).

Click to see large image...

(3) Fill with new engine oil while checking the oil level on the dipstick.

Capacity

Total :

6.7 L (7.08 US qt, 5.89 Imp qt, 1.77 US.gal)

Oil pan :

6.4 L (6.76 US qt, 5.63 Imp qt, 1.69 US.gal)

Drain and refill including oil filter :

6.5 L (6.87 US qt, 5.72 Imp qt, 1.72 US.gal)

NOTICE

- Fill the crankcase to about half the capacity and then fill the remainder after waiting.
- Do not fill oil over the 'F' mark. Frequently check the level with the oil level gauge to ensure no overfilling.

(4) Install the oil filler cap and the oil dipstick.

5. Start the engine and check that no oil is leaking from the drain plug or oil filter.
6. Recheck the engine oil level.

NOTICE

- When rechecking the engine oil level, be sure to warm up the engine sufficiently. Otherwise, the measured engine oil level may not reach the specification.

To reset the service interval to the recommended mileage, refer to the service mode section in the owner's manual for procedure (if applicable).

- Inspection

Engine Oil Level

Information

- Be sure that the vehicle is on level ground.

1. Warm up and stop the engine, and then wait for 5 minutes.
2. Turn the engine off and wait for a few minutes (about 5 minutes) for the oil to return to the oil pan.
3. Pull the dipstick out, wipe and re-insert it fully.
4. Check that the oil level is between the "L" and "F" level marks on the engine oil level gauge.
5. If the level is low, check for leakage and add oil up to the "F" level mark.

Information

- Use a funnel to help prevent spilling the oil on engine components.

NOTICE

- Do not fill the engine with oil above the full level mark.

Engine Oil Appearance

1. Check engine oil for white turbidity or heavy contamination.
2. If engine oil becomes turbid and white, it is highly probable that it is contaminated with engine coolant.
   Repair or replace damaged parts.

Selection Of Engine Oil

Specification

Selection Of Engine Oil
Recommendation
- 5W-30 ACEA A5
Allowed Oil Grade

- Use if recommended engine oil is not available
- API SM or above
- ILSAC GF-4 or above
- ACEA A3

Allowed SAE Viscosity

Click to see large image...

NOTICE

For best performance and maximum protection of all types of operation, select only those lubricants which :

1) Satisfy the requirement of the ACEA classification.
2) Have proper SAE grade number for expected ambient temperature range.
3) Lubricants that do not have both an SAE grade number and ACEA service classification on the container should not be used.
4) For the vehicle equipped with DPF, the service engine oil quality should meet the ACEA C2 or C3 grade. However, oil refill with small amount of ACEA B4 grade between oil change intervals is possible.

- Components

Click to see large image...

1. Oil fliter body
2. Gasket

- Removal

• Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
(Refer to General Information - "Lift and Support Points")

1. Remove the engine room under cover.
(Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Drain the engine oil.
(Refer to Lubrication System - "Engine Oil")
3. Remove the oil filter body (A).

Tightening torque :
23.5 - 25.5 N.m (2.4 - 2.6 kgf.m, 17.4 - 18.8 lb.ft)

Click to see large image...

4. Install in the reverse order of removal

- Components

Click to see large image...

1. Lower oil pan
2. Upper oil pan

- Removal

•

Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
(Refer to General Information - "Lift and Support Points")

[Lower oil pan]

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Drain the engine oil.
   (Refer to Lubrication System - "Engine Oil")
3. Remove the lower oil pan (A).
   Insert the blade of SST (09215-3C000) between the upper oil pan and lower oil pan. Cut off applied sealer and remove the lower oil pan.

Click to see large image...

NOTICE

- Be careful not to damage the contact surfaces of upper oil pan and lower oil pan.

Information

- Insert the SST between the lower oil pan and the upper oil pan by tapping it with a plastic hammer in the direction of ① arrow.
- After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the lower oil pan, remove it from the upper oil pan.

- Do not turn over the SST abruptly without tapping as the SST may get damaged.

[Upper oil pan]

1. Remove the lower oil pan.
2. Disconnect the oil pump solenoid valve extension wiring connector (A).

Click to see large image...

3. Disconnect the oil pump solenoid valve connector (A).

Click to see large image...

4. Remove the front muffler.
   (Refer to Intake and Exhaust System - "Muffler")
5. Separate the compressor.
   (Refer to Heating, Ventilation Air conditioning - "Compressor")
6. Remove the LH exhaust manifold stay (A).

Tightening torque :
24.5 - 35.3 N.m (2.5 - 3.6 kgf.m, 18.1 - 26.0 lb.ft)

Click to see large image...

7. Remove the RH exhaust manifold stay (A).

Tightening torque :
24.5 - 35.3 N.m (2.5 - 3.6 kgf.m, 18.1 - 26.0 lb.ft)

Click to see large image...

8. Remove the surge tank.
   (Refer to Intake and Exhaust System - "Surge Tank")
9. Remove the LH and RH cylinder head cover.
   (Refer to Cylinder Head Assembly - "Cylinder Head Cover")
10. Install the engine support fixture.
    (Refer to Automatic Transaxle System - "Special Service Tools")
11. Remove the timing chain cover.
    (Refer to Timing System - "Timing Chain Cover")

12. Remove the oil pump chain tensioner (A).

Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

13. Remove the oil pump chain sprocket (A).

Tightening torque :

19.6 - 24.5 N.m (2.0 - 2.5 kgf.m, 14.5 - 18.1 lb.ft)

Click to see large image...

14. Remove the transaxle mounting bolt (A) and upper oil pan mounting bolt (B).

Tightening torque

Bolt (A) : 39.2 - 46.1 N.m (4.0 - 4.7 kgf.m, 28.9 - 34.0 lb.ft)

Bolt (B) : 9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

15. Insert the blade of SST (09215-3C000) between the upper oil pan and cylinder block. Cut off applied sealer and remove the upper oil pan (A).

Tightening torque :

9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

- Installation

[Lower oil pan]

1. Install the lower oil pan (A).
   (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
   (2) Before assembling the oil pan, apply liquid sealant TB 1217H on the oil pan. Assemble the part within 5 minutes of applying sealant.

   Bead width :2.5 mm (0.1 in.)

Click to see large image...

NOTICE

- Clean the sealing face before assembling two parts.
- Remove harmful foreign matters on the sealing face before applying sealant.
- When applying sealant gasket, sealant must not protrude into the oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

(3) Install the oil pan (A).

Uniformly tighten the bolts in several passes.

Tightening torque :

11.8 - 13.7N.m (1.2 - 1.4 kgf.m, 8.7 - 10.1 lb.ft)

Click to see large image...

2. After assembly, wait for at least 30 minutes before filling the engine with oil.
3. Install the remaining parts in the reverse order of removal.

[Upper oil pan]

1. Install the upper oil pan.
   a. Using a gasket scraper, remove all the old packing material from the gasket surfaces.
   b. Before assembling the oil pan, apply liquid sealant TB 1217H on the oil pan. Assemble the part within 5 minutes of applying sealant.

Bead width :2.5 mm (0.1 in.)

Click to see large image...

NOTICE

- Clean the sealing face before assembling two parts.
- Remove harmful foreign materials on the sealing face before applying sealant
- When applying sealant gasket, sealant must not protrude into the oil pan.
- To prevent leakage of oil, apply sealant gasket to the inner threads of the bolt holes.

2. Install the remaining parts in the reverse order of removal.

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

1. Remove the upper oil pan.
   (Refer to Lubrication Sytstem - "Oil Pan")
2. Remove the oil pump (A).

Tightening torque :
20.6 - 32.4 N.m (2.1 - 2.3 kgf.m, 15.2 - 23.9 lb.ft)

Click to see large image...

3. Install in the reverse order of removal.

- Removal and Installation

1. Remove the oil level gauge (A) and the oil level gauge rod (B).

Tightening torque:
18.6 - 22.6 N.m (1.9 - 2.3 kgf.m, 13.7 - 16.6 lb.ft)

Click to see large image...

NOTICE

- When installing, apply engine oil to the o-ring and be careful not to damage the O-ring.
- Always use a new O-ring.

2. Install in the reverse order of removal.

- Components

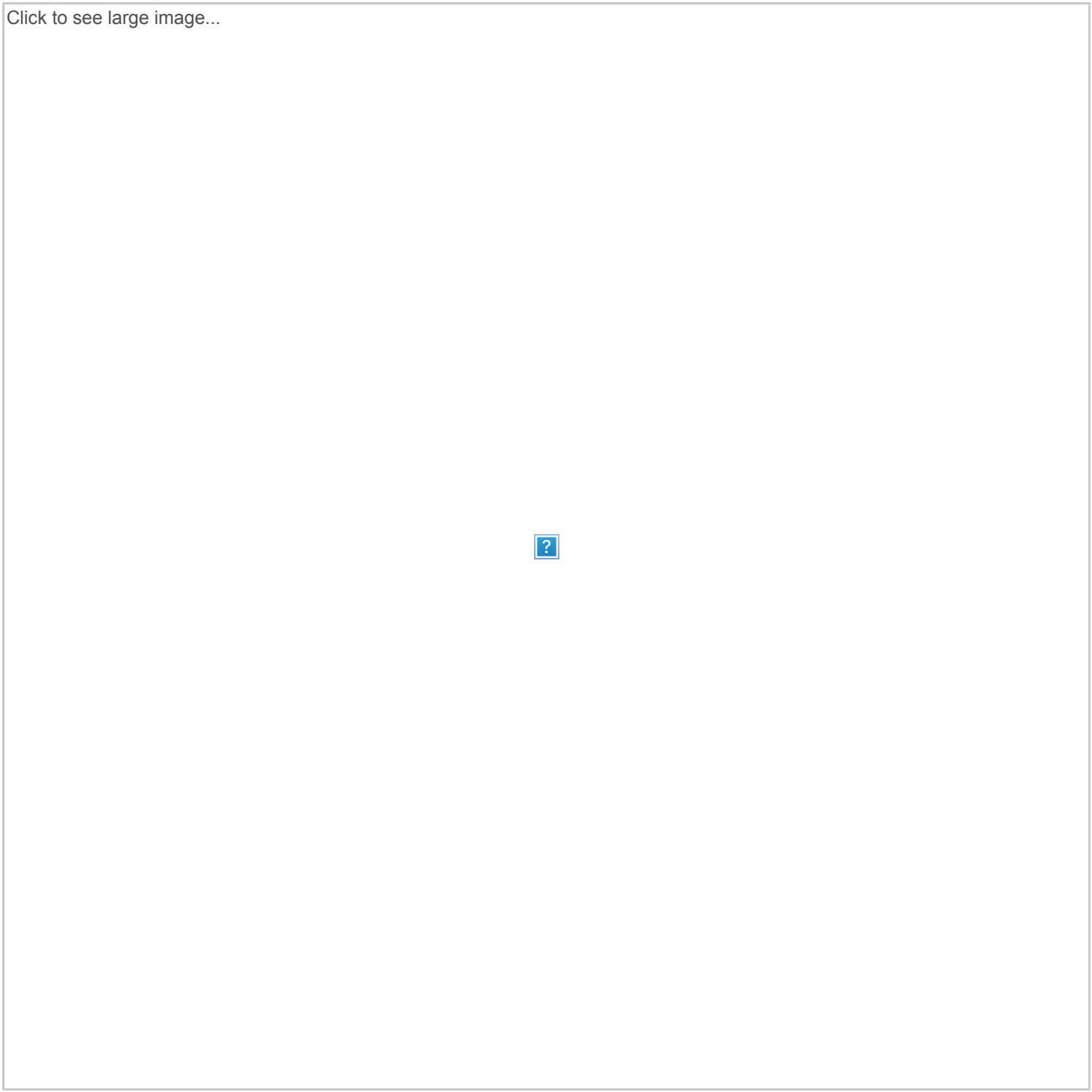
Click to see large image...

1. Air cleaner body
2. Air cleaner cover
3. Air intake hose
4. Air cleaner element
5. Air duct
6. Air intake shield
7. Breather hose

- Removal and Installation

Air Cleaner Assembly

1. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
2. Remove the air duct (A).



3. Disconnect the battery positive terminal.
4. Disconnect the breather hose (A).
5. Disconnect the brake vacuum hose (B).

6. Disconnect the air intake hose (C).
7. Remove the air cleaner assembly (D).

Tightening torque

Hose clamp :

2.9 - 4.9 N.m (0.3 - 0.5 kgf.m, 2.2 - 3.6 lb.ft)

Air cleaner assembly :

7.8 - 9.8 N.m (0.8 - 1.0 kgf.m, 5.8 - 7.2 lb.ft)

Click to see large image...

8. Install in the reverse order of removal.

Air Cleaner Element

1. Open the air cleaner element cover (A) by lifting up the air cleaner element cover handle.

Click to see large image...

2. Unlock the air cleaner element camshaft (A) by turning in the direction of arrow.

Click to see large image...

3. Replace the air cleaner element (A) with a new one.

Click to see large image...

Information

- Grab the handle then pull out the air cleaner element.

4. Lock the air cleaner element camshaft and then close the air cleaner element cover.

- Components

Click to see large image...

1. Surge tank
2. Surge tank stay
3. Positive crankcase ventilation (PCV) hose

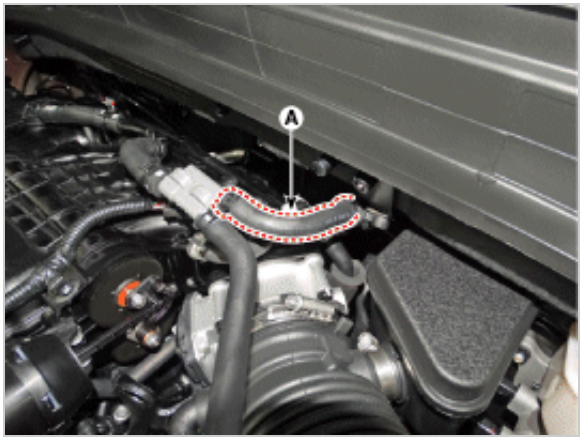
- Removal and Installation

1. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")

2. Remove the air cleaner assembly.
   (Refer to Intake And Exhaust System - "Air Cleaner")
3. Disconnect the wiring connectors and harness clamps and remove the wiring protector around the surge tank.

Click to see large image...

4. Disconnect the brake booster vacuum hose (A).



5. Disconnect the purge control solenoid valve (PCSV) hose (A).

Click to see large image...

6. Disconnect the positive crankcase ventilation (PCV) hose (A).

Click to see large image...

7. Remove the surge tank stay (A).

Tightening torque :
27.5 - 31.4N.m (2.8 - 3.2kgf.m, 20.3 - 23.1lb.ft)

Click to see large image...

8. Remove the surge tank (A).

Tightening torque :
9.8 - 11.8N.m (1.0 - 1.2kgf.m, 7.2 - 8.7lb.ft)

Click to see large image...

9. Install in the reverse order of removal.

- Removal and Installation

VIS 1 [Intake Manifold]

1. Disconnect the battery negative terminal.
2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")

3. Disconnect the VIS actuator hose (A).
4. Remove the VIS actuator (B).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

5. Install in the reverse order of removal.

VIS 2 [Surge Tank]

1. Disconnect the battery negative terminal.

2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Disconnect the VIS actuator hose (A).
4. Remove the VIS actuator (B).

Tightening torque :
9.8 - 11.8 N.m (1.0 - 1.2 kgf.m, 7.2 - 8.7 lb.ft)

Click to see large image...

5. Install in the reverse order of removal.

- Components

Click to see large image...

1. Intake manifold
2. Intake manifold gasket

- Removal and Installation

1. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")

2. Remove the air cleaner assembly.
   (Refer to Intake And Exhaust System - "Air Cleaner")
3. Remove the surge tank.
   (Refer to Intake And Exhaust System - "Surge Tank")
4. Remove the low pressure fuel line mounting bolts (A).

Click to see large image...

5. Remove the intake manifold (A).

Click to see large image...

NOTICE

- Cover the cylinder head intake port with a clean woven stuff or vinyl cover to prevent foreign materials from entering.
- Otherwise, engine coolant may enter the intake port from the vent holes of the cylinder head causing problems in the engine combustion chambers.

6. Install in the reverse order of removal.

NOTICE

- Tighten the intake manifold bolts and nuts, in several passes as below.

Tightening torque

Step 1 (a - h) : 3.9 - 5.9 N.m (0.4 - 0.6 kgf.m, 2.9 - 4.3 lb.ft)

Step 2 (1 - 8) : 26.5 - 31.4 N.m (2.7 - 3.2 kgf.m, 19.5 - 23.1 lb.ft)

Step 3 : Repeat 2nd step twice or more.

Click to see large image...

- Components

Click to see large image...

1. LH Exhaust manifold gasket
2. LH Exhaust manifold
3. LH Heat protector
4. LH Exhaust manifold stay
5. RH Exhaust manifold gasket
6. RH Exhaust manifold
7. RH Heat protector
8. RH Exhaust manifold stay

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

[LH Exhaust Manifold]

1. Disconnect the battery negative terminal.
2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
4. Remove the front muffler.
   (Refer to Intake And Exhaust System - "Muffler")
5. Remove the oil level gauge.
   (Refer to Lubrication System - "Oil Level Gauge & Pipe")
6. Disconnect the LH front oxygen sensor (HO2S) connector (A).

Click to see large image...

7. Remove the LH exhaust manifold heat protector (A).

Tightening torque :
9.8 - 11.8N.m (1.0 - 1.2kgf.m, 7.2 - 8.7lb.ft)

Click to see large image...

8. Disconnect the LH rear oxygen sensor (HO2S) connector (A).

Click to see large image...

9. Remove the LH exhaust manifold stay (A).

Tightening torque :

24.5 - 35.3 N.m (2.5 - 3.6 kgf.m, 18.1 - 26.0 lb.ft)

Click to see large image...

10. Remove the LH exhaust manifold (A).

Tightening torque :

49.0 - 53.9 N.m (5.0 - 5.5 kgf.m, 36.2 - 39.8 lb.ft)

Click to see large image...

11. Install in the reverse order of removal.

NOTICE

- When installing the exhaust manifold, tighten the nuts to pre-torque first and then fully tighten to the specified torque in the sequence shown.

Click to see large image...

[RH Exhaust Manifold]

1. Disconnect the battery negative terminal.
2. Remove the engine cover.
   (Refer to Engine and Transaxle Assembly - "Engine Cover")
3. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
4. Remove the front muffler.
   (Refer to Intake And Exhaust System - "Muffler")
5. Disconnect the RH front / rear oxygen sensor (HO2S) connectors (A).

Click to see large image...

6. Remove the RH exhaust manifold heat protector (A).

Tightening torque :
9.8 - 11.8N.m (1.0 - 1.2kgf.m, 7.2 - 8.7lb.ft)

Click to see large image...

7. Remove the RH exhaust manifold stay (A).

Tightening torque :
24.5 - 35.3 N.m (2.5 - 3.6 kgf.m, 18.1 - 26.0 lb.ft)

Click to see large image...

8. Remove the RH exhaust manifold (A).

Tightening torque :

49.0 - 53.9 N.m (5.0 - 5.5 kgf.m, 36.2 - 39.8 lb.ft)

Click to see large image...

9. Install in the reverse order of removal.

NOTICE

- When installing the exhaust manifold, tighten the nuts to pre-torque first and then fully tighten to the specified torque in the sequence shown.

[2WD]

Click to see large image...

[AWD]

Click to see large image...

- Components

[2WD]

Click to see large image...

1. Front muffler
2. Catalytic converter & Center muffler assembly
3. Rear muffler
4. Gasket
5. Hanger

[AWD]

Click to see large image...

1. Front muffler
2. Catalytic converter & Center muffler assembly
3. Rear muffler
4. Gasket
5. Hanger

- Removal and Installation

- Be careful not to damage the parts located under the vehicle (floor under cover, fuel filter, fuel tank and canister) when raising the vehicle using the lift.
  (Refer to General Information - "Lift and Support Points")

Front Muffler

1. Remove the engine room under cover.
   (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
2. Remove the roll rod bracket.
   (Refer to Engine and Transaxle Assembly - "Engine Mounting")
3. Remove the sub frame.
   (Refer to Suspension System - "Sub Frame")
4. Remove the front muffler (A).

Tightening torque :
39.2 - 58.8 N.m (4.0 - 6.0 kgf.m, 28.9 - 43.4 lb.ft)

Click to see large image...

Click to see large image...

5. Install in the reverse order of removal.

> **NOTICE**
>
> • When installing, replace with new gaskets.

Catalytic converter & Center Muffler Assembly

1. Remove the catalytic converter & center muffler assembly (A).

Tightening torque :

39.2 - 58.8 N.m (4.0 - 6.0 kgf.m, 28.9 - 43.4 lb.ft)

Click to see large image...

2. Install in the reverse order of removal.

NOTICE

- When installing, replace with new gaskets.

Rear Muffler

1. Remove the rear muffler (A).

Tightening torque :
39.2 - 58.8 N.m (4.0 - 6.0 kgf.m, 28.9 - 43.4 lb.ft)

Click to see large image...

2. Install in the reverse order of removal.

NOTICE

- When installing, replace with new gaskets.

Replacement procedure of catalytic converter & center muffler assembly using clamp

Under warranty : Replace the catalytic converter & center muffler assembly.

Out of warranty : Catalytic converters and center muffler assemblies can be replaced in the following procedure:

1. Check if the clamping part of the catalytic converter & center muffler assembly is damaged or deformed.
   If the muffler is too corroded to clamp, replace the catalytic converter & center muffler assembly.

Click to see large image...

2. Record the gap (A, B) between the tail pipe and the rear bumper.

Click to see large image...

3. Remove the catalytic converter & center muffler assembly (A).

Click to see large image...

4. Cut the catalytic converter & center muffler assembly as in the instruction below.
   – Cut the front groove of the muffler.

Click to see large image...

[Replacement muffler]

– Cut the rear groove of the replacement muffler.

Click to see large image...

NOTICE

- To prevent leakage, remove any rust on the clamping part or the burr on the cutting part.
- Cut the pipe vertically.

Information

- Use a pipe cutter to cut the pipe vertically.

Click to see large image...

- If pipe cutter is unavailable, use a hacksaw as in the procedure below.

1) Mark the cutting position to cut the pipe vertically.

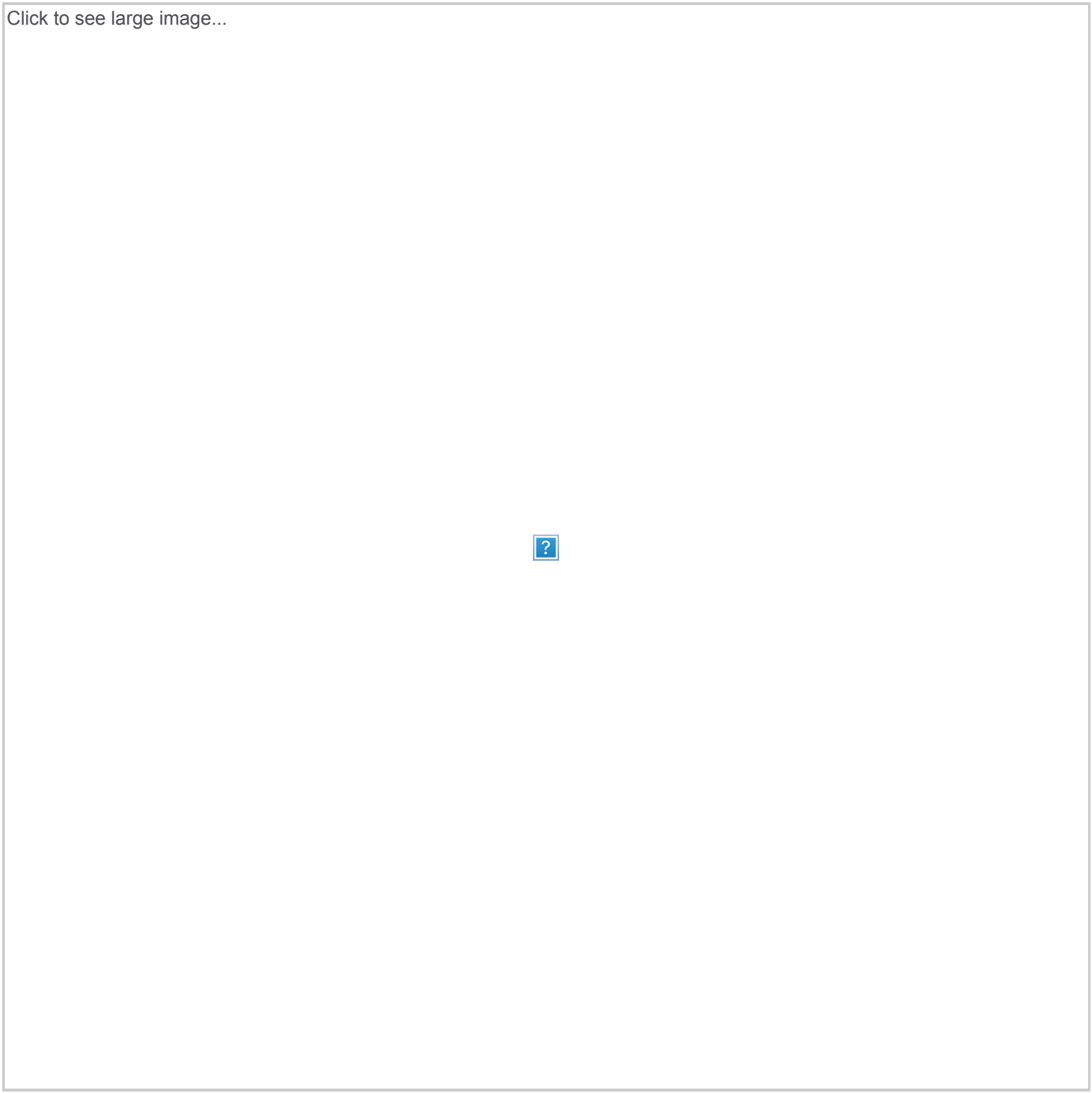
Click to see large image...

2) Cut the pipe along the marked line by using a hacksaw.

Click to see large image...

5. Install the center muffler.
   (1) Install the catalytic converter (A) and the center muffler (B) for replacement by partially tightening the nuts.

Click to see large image...



(2) Place the clamp (A) between the cutting part of each pipe and partially tighten the clamp.

Click to see large image...

(3) Tighten the catalytic converter and the center muffler to the specified torque.

Tightening torque :

39.2 - 58.8 N.m (4.0 - 6.0 kgf.m, 28.9 - 43.4 lb.ft)

(4) Compare the gap between the tail pipe (or tail trim) and the rear bumper with the measurement taken before removing the center muffler assembly.

NOTICE

- If the tail pipe is installed differently from the initial position, the bumper may get damaged by the pipe heat or interference between the tail pipe and the rear bumper.

(5) Do not tighten the clamp at a time. Tighten the clamp nuts to the specified torque, by turns.

Tightening torque :

17.6 - 23.5 N.m (1.8 - 2.4 kgf.m, 13.0 - 17.4lb.ft)

Click to see large image...

NOTICE

- Do not reuse clamps that have been tightened completely. Reusing clamps that have been tightened completely may cause leakage.